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AMERICAN MACHINIST

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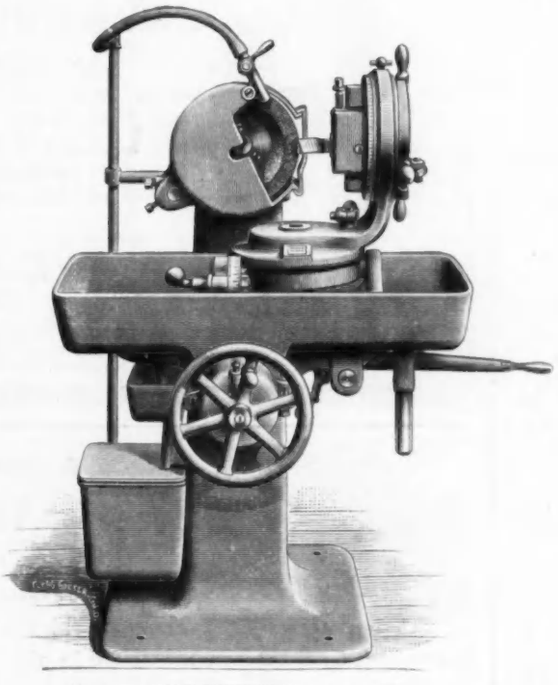

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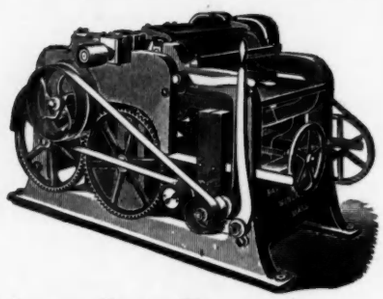

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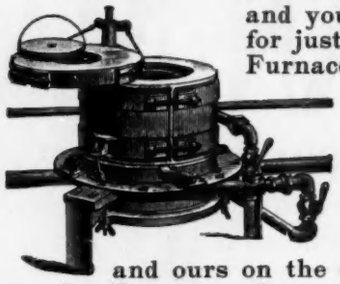

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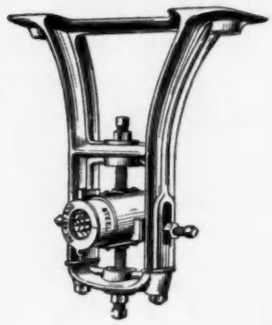

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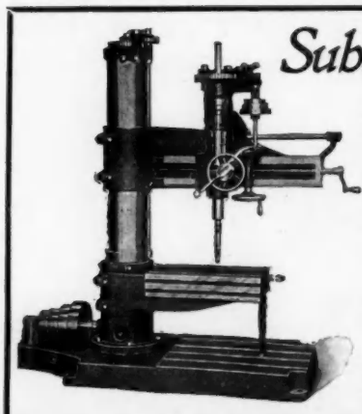

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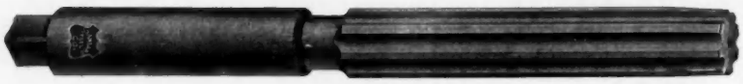

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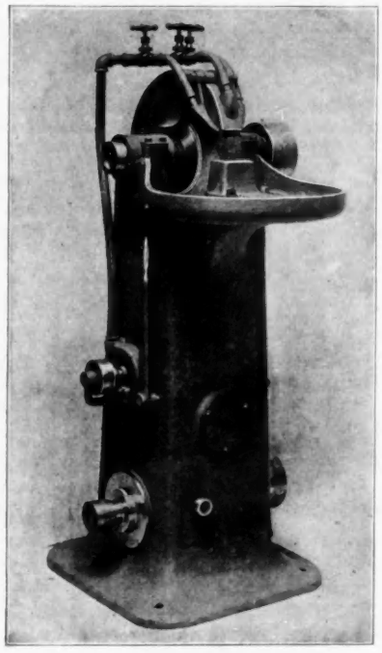

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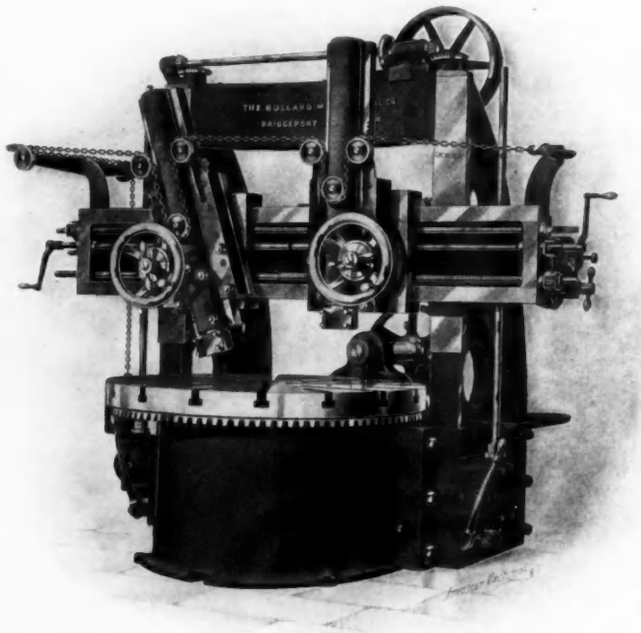

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The Mechanical Engineers.

The American Society of Mechanical Engineers is to be congratulated anew upon its continued prosperity and its constant growth. No meeting in its history has been more profitable and a greater all round success than that which we report in our present issue; at the same time it was not a tame repetition of the characteristics of any previous meeting, but had novel and distinctive features of its own. It was a unique occurrence that the world-honored Chief of the Bureau of Steam Engineering of the United States Navy was also at this meeting the president of the society, and his annual address could not have been more fittingly directed than, as it was, in narrating the achievements of American naval engineers, and in urging for them full recognition and opportunity.

The papers presented at the meeting were practical, rather than speculative, and elicited interesting and profitable discussion, of which the well considered written contributions formed an important part, and constituted a strong indorsement of the recent practice of the society of sending out advance copies of the papers to all the membership. As the full list of papers and an account of their individual treatment is elsewhere given it is not necessary here to go over it again. If some received little or no discussion it was not that every available minute of all the meetings was not fully occupied.

Two or three of the papers presented were of unusual interest and importance. That of Professor Thurston upon "The Steam Engine at the End of the Nineteenth Century," we may well believe some patronizing wiseacres will be referring to a hundred years from now. It may then have become a scientific and literary curiosity only, and the last steam engine may have given its last puff years before that. Who can say? Things have quite a habit of soon being superseded after their ultimate possibilities have been developed, and it is not difficult to believe that the steam engine may go the way of all the rest. If Professor Thurston's paper sooner or later becomes ancient history, it will not be history to be ashamed of.

A most important and valuable paper, and one which in the circumstances of its presentation and discussion received the highest marks of appreciation which the society can bestow, was that of M. P. Higgins upon "The Education of Machinists, Foremen and Mechanical Engineers." Professor Higgins, as most of our readers should know, was for a score of years the head of the machine shops connected with the Worcester Polytechnic Institute, and we also know of his phenomenal success in that position. We believe that no paper was ever presented before the society in which the members showed a greater interest. The written contributions in connection with it were unusually numerous and of the highest character, and the oral discussions protracted the meeting to a very late hour, with a crowded auditorium to the last minute. The discussions were in no mercenary spirit, but showed the earnest desire of all present to know and to do the best for the advancement and maintenance of a high standard of skill and efficiency in our shops, from the lowest to the highest of its workers. The boys and young men of America who aim to be its best mechanics and engineers have no more helpful friends than the A. S. M. E., if the meeting at which this paper was presented goes for anything.

At the last session of the society, on Friday morning, there was presented the necessarily voluminous but every way admirable paper by Mr. Walter C. Kerr upon "The Mechanical Equipment of the New South Station, Boston, Mass." This paper came as a complete surprise, as advance copies had not been sent out and the title even of the paper had not appeared on the list. It told in the clearest and most straightforward manner of the highly successful accomplishment of a most magnificent work. The discussion, which was, of course, oral and entirely unpremeditated, opened the important question of the status of the consulting engineer in American practice, a topic which it is to be hoped may be further discussed at future meetings. The discussion, as far as it went, at least suggested that there is still much which might be and which should be said upon both sides of this important question. We have learned at least thus far the important fact that, if the question of employing the consulting engineer or of letting the contracting engineer do it all is one principally as to the temptation involved, "it is better to tempt one man twice than to tempt two men once."

The attendance at the meeting was considerably larger than ever before recorded, and the number of additions to the permanent membership of the society at this meeting was also exceptionally large. The meeting room of the society has long been too small, and its insufficiency becomes seriously detrimental to the best interests of the society. Many are now debarred from active participation in the meetings, and it is none too soon to begin a movement for better accommodations, although it must be conceded that for 360 days of the year the present house is a very satisfactory place. The library, however, is beginning to clamor for more room, so that we hope soon to see the beginning of some action which the future of the society demands.

The American Society of Mechanical Engineers evidently has no more popular or universally respected member than Charles T. Porter, and the members palpably exulted in the pluck of their venerable co-laborer when he announced that he wanted the last page of the record of steam engine attainments of the nineteenth

century for a record of his engine, by which he expects to attain a water consumption of 9 pounds per hour per horsepower, by using steam at 300 pounds pressure, together with other innovations specified by him. The audience also relished the joke which he told, apparently at his own expense. He was thirsty, and was compelled to ask President Melville for water repeatedly. At last on such an occasion he told of a member of the New York Legislature who stopped in the midst of a long harangue to drink water, when a member rose to a point of order, and on being asked what was his point of order he said he thought it was out of order for a windmill to run by water.

Life of Charles Potter.

As illustrating the way in which American inventors and manufacturing specialists rise and establish themselves, the life of Charles Potter, the founder of the Potter Printing Press Company, is well worth telling more fully than was done in our brief obituary notice previously published.

Mr. Potter's father was a carriage builder living at Brookfield, Madison County, N. Y., where the son was born in 1824. In 1837, on account of ill health, the carriage building was given up, and the father took a farm in the northern part of the State. The son had attended the ordinary district school pretty constantly up to this time, but for the next nine years he worked steadily on the farm in the summer, attending an academy in the winter, and finally teaching school for three terms, a very common record for the young man of the period. In the autumn of 1846 he went to Westerly, R. I., where he lived for a number of years. Instead of going to Yale, studying agricultural chemistry and engaging in scientific farming, as had been planned by both his father and himself, circumstances drove him to become a clerk in a lumber and building business. Here he displayed much business ability, and in 1849, a stock company having been formed to take up a broken down foundry business, he was put in practical charge of it. He not only managed the finances, but he made all the drawings and many of the patterns, and the business prospered. In 1854 the late George H. Babcock, afterwards of the Babcock & Wilcox Company, had, with his father, invented a printing press for printing three colors at once. The press was of small size and run by foot power. Mr. Potter left the foundry, in spite of urgent inducements to stay, and arranged with the Babcocks to take the invention, have the presses built at his own expense, put them on the market or sell the patent and divide the net profits equally. He had a cash capital of $250, and early in 1855 he took the press to New York and opened an office. Another novel press, invented by Marvin Davis, was soon after offered to Mr. Potter upon the same terms as the Babcock press, and as it was for another line of work, he took that also, in 1855 and 1856 exhibiting both presses at the American Institute fair and receiving gold and silver medals. In 1857 Mr. Babcock patented an excellent job press, and that was added to the list, but after this press had been on the market two years, gaining great favor, a competitor threatened suit for infringement, and Mr. Potter sold out the presses on hand and retired from that part of the business.

Mr. Potter built his first cylinder press in 1857, making the drawings and a large part of the patterns for the same himself, and he continued to design his own presses until the rapidly increasing demands for his machinery compelled him to devote his time to the financial and general mechanical operations of the business. After making his first cylinder press, with his illustrated circulars in his pocket he canvassed for its sale, and, on getting orders, came back and built his presses, and then went out and erected them and set them at work. This he did for many years, and in doing it he became acquainted with probably more proprietors of newspaper and job-printing offices than any other individual of his time. Thus he not only sold his machines, but he also gained great experience in the needs of the presses, and in those characteristics which go to help the printer in the use of the press. In this way, gaining his information and embodying it in his machines, he built a press that had the reputation of standing at the head of that class of machinery. In his canvassing for orders his competitors gave him the credit of being the best salesman in the field, successful for the reason that he never promised anything for his presses that they would not do, and therefore gained the confidence of everybody with whom he dealt.

Mr. Potter's presses were built mainly in Westerly, R. I., until 1865; thereafter, until 1879, they were built at Norwich Conn. In 1865, the business having grown too great to be managed by himself alone, he formed a partnership with Mr. J. F. Hubbard, and the firm name was changed to C. Potter, Jr., & Co. In 1879, after a pleasant partnership of fourteen years, Mr. Hubbard's health failed and he retired from the firm. Mr. Potter then built his shops in Plainfield, N. J., the main shop being 250 feet in length by 60 feet in breadth. Subsequently it was enlarged to 700x100 feet, and is still too small for the business.

After the retirement of Mr. Hubbard from the firm, Mr. Potter admitted to a share in the business Mr. H. W. Fish and Mr. J. M. Titsworth, and a little later Mr. D. E. Titsworth, all of whom had been long in his employ. Mr. Potter added to the class of presses that he had built the varieties of two-revolution, lithograph, drum-cylinder and web presses, and in each of these classes his machinery was unexcelled. He had been actively engaged in building printing machinery for a longer time than any other man in this country, and to him is largely due its wonderful evolution. 1893 the company was changed from a private company to a corporation, with the same owners as before, Mr. Potter being the president of the company.

Mr. Potter never allowed himself to be tempted from his one special business of manufacturing printing presses, however strong the temptation might be. His aim was always to do well whatever he undertook, and for this reason, and because of his business ability, he had a successful career. His generosity and his devotion to his church and to every charitable cause kept pace with his progress in the financial world.

Mr. Potter had four daughters, who all married, and two of his sons-in-law are treasurer and secretary of the company, respectively. As previously noted, Mr. Potter's religious views led to the running of his factory but five days in the week, as no work was ever allowed to be done within it on Saturday.

Examination for Architectural and Structural Steel Draftsman.

The United States Civil Service Commission announces that on January 9, 10, 11, 1900, examination will be held in any city where it has a board of examiners for the position of architectural and structural steel draftsman.

The minimum age limitation for entrance to this examination is twenty years; no maximum.

From the eligibles resulting from this examination certification will be made to the position of architectural and structural steel draftsman in the Bureau of Yards and Docks, Navy Department, in the Yards and Docks Department at Boston, Mass., and at League Island, Pa., the first two at a salary of $4 per diem each and the last named at a salary of $4.50 per diem.

This examination is open to all citizens of the United States who comply with the requirements. All such citizens are invited to apply. They will be examined, graded and certified with entire impartiality and wholly without regard to any consideration save their ability as shown by the grade attained by them in the examination.

Persons desiring to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application forms 304 and 375, which should be properly executed and promptly forwarded to the Commission at Washington.

On the evening of December 16, at the regular meeting of the Engineers' Club of Philadelphia, No. 1122 Girard street, Philadelphia, Charles J. Dougherty will read a paper entitled "The Electrical Process of Annealing Armor Plates in the Construction of War Ships."

Commercial Review.

NEW YORK, SATURDAY EVENING,
December 9, 1899.

MACHINISTS' SUPPLIES.

Little cause for complaint of the year's closing market exists in the auxiliary lines of machine shop necessities. That disposition which is inevitable at the close of the year to postpone stock orders until after inventory is taken is responsible for some hesitation on the part of buyers who want supplies to sell over again, or for their own use in the uncertain future, but the ultimate distribution of goods for immediate consumption proceeds rapidly. This month bids fair to rank far above Decembers in other years. The outlook for 1900 is excellent.

The trade are curious to know what sort of a turn the unfinished iron and steel market will take after the first of the year, for this will determine in great measure the course of manufactured products. It is taken for granted that there will not be much change in raw materials this month, but there is no settled conviction that a maximum has yet been attained.

Manufacturers of power transmitting machinery still report a very active trade. In one notable instance it is stated that practically no contracts are now accepted by the company on less than two months' time for delivery, except in the way of small sales from stock, and even in these it is difficult to meet customers' requirements. One house reports a continued stiffening in the price of its wood split pulleys, and says that buyers have not been at all frightened by the advances of 25 per cent. that it made this year. The local manager of a company which manufactures a varied assortment of power transmission material speaks of a particularly good demand for friction clutches. This is a matter of gradual growth, and seems to result from a general tendency to employ up-to-date shop appliances. Another power transmission line which has lately been in considerable requirement and might be called a feature of the present market, is rope drives. The A. & F. Brown Company has received a contract for a large rope drive to go in a textile mill to be erected in Passaic, N. J., for German parties. The A. & F. Brown Company shipped last week to the Ames, Neb., works of the American Beet Sugar Company (a Spreckels interest) a large quantity of shafting, pulleys, gearing, hangers, etc. They are filling large contracts for the McCormick Harvesting Machine Company, Chicago.

To return to the subject of rope drives —the Dodge Manufacturing Company has contracts for the installation of several of these, particularly in the Eastern part of New York State, where plants exist which have been the subject of various additions, and which now desire some good method for connecting the different parts. Rope drives are going in in Albany, Cohoes and Troy. Among other contracts of the Dodge Manufacturing Company—which is greatly crowded with work—is a transmission equipment for a sawmill at Castorland, N. Y.

SIDE LIGHTS ON TRADE.

A symptom of more plentiful stocks of certain tools: Lately a local party, having occasion to exchange a key seater for a cutting-off machine, was surprised to find several of the latter in stock. He says that six months ago he would have had to wait three or four months for one.

Machines hard to obtain: Not many weeks ago a power transmitting apparatus company in the West needed some band saws, and in order to get hold of them had to call in those which had been in use at its distributing branches for sawing up boxes. The distributing houses are now sawing up boxes with rip saws by hand.

"Our greatest embarrassment at present is to obtain cars for transporting our goods," says a wood pulley manager. "For economy's sake we require full-sized furniture cars, in order that we may stow in the greatest weight we can. The car famine is such that in the town where our factory is located one railroad was lately seventy-five furniture cars behind the demand."

The suggestive point is made by a member of a local supply firm that in spite of the barrenness of stocks in sales houses so much talked about this year, stocks have really been heavier than usual, only they have been small in comparison with the increased volume of business. His own firm has found it necessary to add to its stock to cope with increased trade. Their business for September of this year was 64½ per cent. greater than that for September a year previous, and a 30 per cent. increase has been the smallest for any month of this year. Under these conditions they have felt that heavier stocks were an absolute necessity if they were to carry on business successfully, and in spite of some difficulty in so doing they have obtained the goods from the manufacturers. One cannot but remark that the manufacturers were more pliant than those with whom some sellers had to deal. The stock of saws on hand, for instance, was increased to fill enlarged store facilities that were made for it, and wareroom changes to afford more space are almost constantly being made in various departments. Last spring the shafting bins were pretty nearly empty, but the state of trade seemed to require that these should be filled up, and now they contain something like 100 tons.

We spoke last week of a notably copious list of tools in stock or for early delivery offered by a New York firm. In subsequent conversation with a traveling man for a line closely allied to machine tools the fact was alluded to. "Oh, yes," said he, "you mean" so and so (referring to a New England selling firm). "They got such a list printed some three weeks ago. It is the first time I have seen such a thing for eighteen months. It included milling machines, screw machines, shapers, drill presses and one or two dozen planers—good, new tools." As it happened, the list he had in mind was a different one from that which we had seen, and goes to strengthen the argument that dealers' stocks are filling up. After what we said last week about planers we may be asked to crawl at the above mention of that tool, but conclude, on the whole, that it is unnecessary. One swallow does not make a summer, nor one or two dozen. The man who doesn't know that planers are a scarce tool would not know a planer if he saw one. There were some planers, by the way, on the New York list, and inquiry by a would-be purchaser brought out the fact that they were not for very early delivery, after all. There is probably no superfluity other than in certain lines of light tools.

MISCELLANEOUS.

The Cleveland Twist Drill Company is taking occasion, with the erection of the addition to its plant, to install an electrical power transmission system throughout, which is pronounced a model of its kind. The system employed is an alternating current one, the motors driving line shafting. Westinghouse electrical machinery is used. Half of the plant is equipped by this time.

The Columbia and Electric Vehicle Company, Hartford, is trebling its plant. A visitor at the new building lately said that it had gotten as far as the third story.

The Manhattan Elevated Railway Company is said to have more than enough applications to dispose of all its old dummy engines that will be taken off when electric traction is installed. They come from as far as St. Petersburg, but are chiefly from American contractors who are building new roads.

November business of the Bullock Electric Manufacturing Company was the best in its history, and it is so overwhelmed with orders that it is advertising for bids to extend its main building 200 feet. Sales included three 600-kilowatt alternators to the Willson Aluminum Company, Holcomb's Rock, Va.; two 150-kilowatt direct-current generators to the Manchester (England) "Sporting Chronicle;" a 100-kilowatt direct-current generator and three 50 horse-power teaser printing press equipments to John Wanamaker, Philadelphia, and three 50 horse-power teaser printing press equipments to Arthur Pearson, of "Pearson's Magazine," London, England.

NOTES ON EXPORT TRADE.

The managing partner in a New York tool and supply firm which is among those most closely in touch with the French market, speaks substantially as follows:

"We are receiving some good orders from France, and trade in that quarter is doing itself thorough justice as compared

with other parts of Europe, especially in view of the obstacles which the exporter to France must encounter. The French are conservative in their machine-shop methods. They do not lose their heads installing new machinery before it is necessary. When they have been running behind with orders six months or a couple of years they begin to think it is time to add to their equipment. They do not work on the policy of accumulating a stock of goods. An American manufacturer, when he has a chance and thinks prospects will justify it, goes to work and turns out forty or fifty machines to keep on hand; but the Frenchman will only make two or three, to use as samples, and machines that may be required for customers are not built till the orders for them come in. When we undertook the French agency of a certain machine tool manufacturing company, which we now hold, they were incredulous that we could do anything with it. 'You may try it if you want to,' said they, 'and we'll stick to you through thick and thin, but we don't expect to see any results. We have tried the market ourselves and we couldn't get much of anything out of it.' The results have been such as to surprise these manufacturers.

"The high prices for American tools are not hurting our French trade much at present, because prices are just as high over there as they are here. Last spring and summer our European export trade in some lines, such as pipe and bolts, completely collapsed because of the advances in the American market, and this was true to some extent of tools. We were apprehensive that the monetary advances made by the tool manufacturers on this side would have a disastrous effect upon foreign trade, but European builders have caught up with us on prices. Some material advances have been made by them at a recent date. Iron in pig and other forms seems to be at least as scarce and costly in England and Germany now as it is in America. I understand that the German pipe market is still about 15 per cent. below the American.

"The preparations for the World's Fair have had much influence upon general mercantile conditions in France. Where so many thousand men are kept busy it stimulates prosperity in all lines. But, conversely, when the work is over and all these men are dropped out of employment, like waiters in a summer hotel, a reaction will come."

DAYTON (OHIO) NOTES.

The manufacturers in iron and steel lines here interviewed by a correspondent of the "American Machinist" during his present visit find that the business of November kept up remarkably well for the time of the year. With the orders on hand and new ones coming in, they have entered December enabled to keep a large force of men steadily at work, and there is a fair prospect that this state of affairs will continue through the early months of 1900, though a little falling off is to be expected at the tansition of the new year.

The New Era Iron Works Company is in the midst of moving and fitting up its new building, 300 x 175 feet, three stories. The motive power will consist of three new gas engines, one of 50 horse-power, for the main shop; one of 20 horse-power, for the foundry, and a 20 horse-power for electric light plant to furnish 200 lights. They have given quite a large order for new machine tools, some of which have been shipped. They hope to be in full operation by January 1. Several new orders for gas engines were taken in November, and they have about closed contracts to build some engines from 80 to 100 horse-power. Their business this year has been some 40 per cent. ahead of last. They have lately been working 120 men 15 hours a day.

The trade of the Brownell Company, one of the old established concerns of this place, has been excellent this year. Engines have sold well, and for boilers and tanks, which form the leading part of their business, the demand has been heavy. They have had some difficulty in securing material, which has hindered them in filling orders with the promptness they like.

The Gem City Boiler Company is an old concern here, whose business has been very good this year, enabling them to keep sixty men steadily employed, forty of whom have been doing night work. Their orders have been mostly for large boilers and batteries. Their trade extends to all parts of this country. They have had some export trade, having made some shipments to Norway and to Mexico, Central America and South American Countries.

Graves & Marshall is another firm engaged in the manufacture of boilers. They find an increase of 30 per cent. over their business of 1898. While most of the business has been in filling home orders they have had some demand for boilers to go to South America. They employ fifty men and have done much night work in filling orders.

CHICAGO MACHINERY MARKET.

Trade in electrical equipment for December is of goodly volume, but the propinquity of the holiday season is reflected to a noticeable degree in the volume of business. There is a slight slackening of inquiry, though that which remains is by no means inconsiderable. It may be near the truth to say that there is no decidedly new impulse towards trade, but that the gathered forces of the past carry along business in the electrical line as well as all other industries at a satisfactory pace. Enterprises are in progress in all fields of industrial effort, and electrical power has won its way to a greater or less degree into almost all of them. Trade has therefore settled down to somewhat of a routine character, with less of the missionary spirit abroad and with more business coming to the makers by mail and without solicitation.

The anticipation is that after the new year opens there will be quite a lot of new work to figure on. The change of the Kansas City railway system from cable to electrical power is now in progress, and will be completed shortly. Ohio continues the banner state for interurban electrical railway work, but in that line there is now some activity in Indiana. The South Side Elevated road at Chicago has just bought two 110 horse-power motors from the Crocker-Wheeler Electric Company to operate water-cooling towers recently erected. Manufacturing plants continue good buyers of equipment. G. A. Crosby & Co. of this city have put into their machine shop a 150 horse-power generator and motors of corresponding power. The Stockham Manufacturing Company of Chicago is installing a 75 horse-power generator at its new foundry. The Grand Rapids (Mich.) Malleable Iron Works are putting in a 200 horse-power generator and motors. Among recent newspaper orders is that of the Minneapolis Tribune for twenty-five motors.

Quotations.

NEW YORK, Monday, Dec. 11, 1899.

Iron—American Pig, tidewater delivery in 1900:—

Pennsylvania Irons:	
No. 1 X foundry	$25 15 @ $26 70
No. 2 X foundry	24 15 @ 24 70
No. 2 plain	23 15 @ 23 70
Alabama Irons:	
No. 1 foundry	22 75 @ 23 50
No. 2 foundry	21 75 @ 22 50
No. 3 foundry	20 75 @ 21 50
No. 1 soft	22 75 @ 23 50
No. 2 soft	21 75 @ 22 50
Foundry forge	20 50 @ 20 75

Bar Iron — Base sizes — Refined, mill price on dock, 2.20 @ 2.30c.; store price, 2.60c., weak; common from store, 2.50 @ 2.60c.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—Ordinary brands from store, 2.90 @ 3c.

Cold Rolled Steel Shafting—Base sizes—From store, 4c. in small lots.

Copper—For Lake Superior ingot, 16¾ @ 17c.; electrolytic, 16¼ @ 16½c.; casting copper, 16 @ 16¼c. Higher prices for electrolytic and casting are still quoted by a prominent market factor.

Pig Lead—Wholesale lots, 4.65c. for December, 4.70c. for January; carloads, 4.70 @ 4.80c.

Pig Tin—In 5 and 10-ton lots, f. o. b., New York, 25¾ @ 26c.

Spelter—Prime Western, 4⅝ @ 4⅞c.

Antimony—In cask lots or over, Cookson's, 10.90 @ 11¼c.; Hallett's, 9¾ @ 9⅞c.

Lard Oil—Prime City, present make, 44 @ 47c. in jobbing lots.

Charles H. Morgan, President American Society of Mechanical Engineers.

The newly elected president of the American Society of Mechanical Engineers comes from a city which has long been famous for its manufactures, and especially for the great variety and high excellence of the machinery made there. He was born and has spent his life up to this time in what may properly be characterized as an atmosphere of mechanics.

Charles Hill Morgan was born in 1831, of New England parentage. His father, being a mechanic of limited means, Charles was obliged to work in a factory at the age of twelve, his early education being such as was afforded by the Massachusetts district school of sixty years ago and the Lancaster Academy. When fifteen he entered the machine shop of his uncle, J. B. Parker, of Clinton, Mass., as an apprentice.

At seventeen he determined to learn mechanical drawing, and through his efforts a class for the study of this subject was formed, and was taught by the late Mr. John C. Hoadley, who was an honored member of the American Society of Mechanical Engineers, then civil engineer of the Clinton Mills. Those few lessons in drawing, taken at night after twelve hours of work in the shop, were one of the most important factors in establishing Mr. Morgan's mechanical career, and this is probably true of several others that were members of that class also.

In 1852, when twenty-one, Mr. Morgan was put in charge of the Clinton Mills dye-house. He then devoted himself to the study of chemistry with great zeal, and filled his new position with entire success, gaining valuable experience in the management of workmen.

For a time Mr. Morgan was draftsman for the Lawrence Machine Company. Later, from 1855 to 1860, he was mechanical draftsman for the distinguished inventor and manufacturer, Erastus B. Bigelow. In association with him and Charles H. Waters, the agent of the Clinton Wire Cloth Mills, Mr. Morgan gained an invaluable experience, and may be said to have been then trained in a hive of invention.

Mr. Morgan introduced a system of designing and constructing cam curves for looms which proved of great usefulness, and was later the subject of a valuable paper read before the Worcester Polytechnic Institute, and subsequently published by the author in pamphlet form.

In 1864 Hon. Ichabod Washburn was in need of a superintendent for his works for the manufacture of wire, at Worcester, Mass. His friends at Clinton, engaged in the manufacture of machinery and wire cloth, warmly recommended Mr. Morgan, who was accordingly engaged as superintendent of manufacturing for the firm of Washburn & Moen. Four years later, when a joint stock company was organized and incorporated under the name of The Washburn & Moen Manufacturing Company, Mr. Morgan was general superintendent. He made seven different visits to Europe for the purpose of visiting the mills of England, Belgium, Germany, France and Sweden, and by these visits and such other means as he could command he kept himself thoroughly informed of all changes made or improvements adopted. The fruit of this devotion was seen in the increased excellence, variety and amount of the company's manufactures. He was for eleven years one of the directors of the company.

CHARLES H. MORGAN, PRESIDENT AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

An advance step in the wire business with which Mr. Morgan has been prominently identified was the development of the continuous rolling mill, designed and originally constructed in Manchester, England, by Mr. George Bedson. This continuous rolling constituted a great advance on the ordinary rolling previously practiced. After starting the Bedson Mill in Worcester, in 1869, it became evident that its production was limited by the imperfections of the ordinary hand reel. Mr. Morgan's first improvement was a power reel; the second one, the practical development of a continuous train of rolls, having horizontal rolls only. (The first rolling mill had, alternately, horizontal and vertical axes.) Experience has shown that this mill, consisting of series of horizontal rolls with intermediate twist guides between the rolls, giving the metal one-quarter of a turn in its passage from one pair of rolls to the next, is far superior to a mill with alternate horizontal and vertical rolls.

Nine years after the construction of the Bedson Mill, another one was built on the Belgian and continuous plans, from designs furnished by Mr. Morgan. This mill, the result of his studies, was known as the Combination mill.

The third improvement was the invention, by Mr. Morgan, of automatic reels, both of the pouring and laying types, such as are now in common use in every rod mill in the country. These reels were completed and a successful test made of them March 10, 1886.

Since severing his connection with the Washburn & Moen Manufacturing Com-

pany in 1887, Mr. Morgan has devoted his attention to the Morgan Spring Company, manufacturers of wire and springs, founded in 1881, and the Morgan Construction Company, of Worcester, Mass., manufacturers of rolling-mill and wire-drawing machinery.

The work of Mr. Morgan and his associates in the last-named company has been very successful, and their designs and machinery are being widely adopted by an appreciative class of manufacturers. The continuous rolling of such material as billets, merchant bar, rods and hoops, together with the disposition of the product after it has been rolled has been given special attention, and a large number of important installations have been made. The continuous method of heating billets, while not strictly new in itself, has been carefully developed and introduced, culminating with the continuous gravity-discharge furnace invented by Mr. Morgan.

Mr. Morgan has never entered political life, but is active in religious, corporate and educational lines. The subject of educational institutions he has always given careful study, and he has been closely identified with the growth and success of the Worcester Polytechnic Institute, having been a member of its board of trustees since the institution was founded, nearly thirty-four years ago. He is a member of the British Iron and Steel Institute and of the American Institute of Mining Engineers and joined the American Society of Mechanical Engineers May, 1881, one year after its organization.

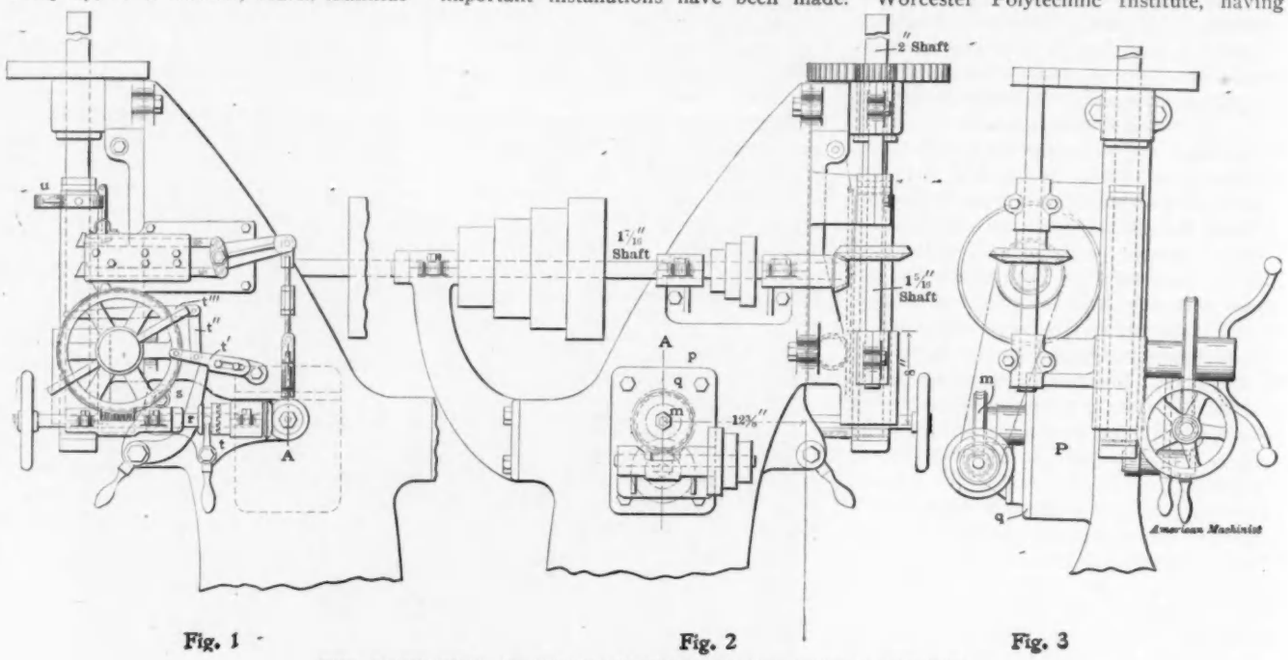


Fig. 1 Fig. 2 Fig. 3

FEED MECHANISM OF AUTOMATIC VARIABLE FEED DRILLING MACHINE.

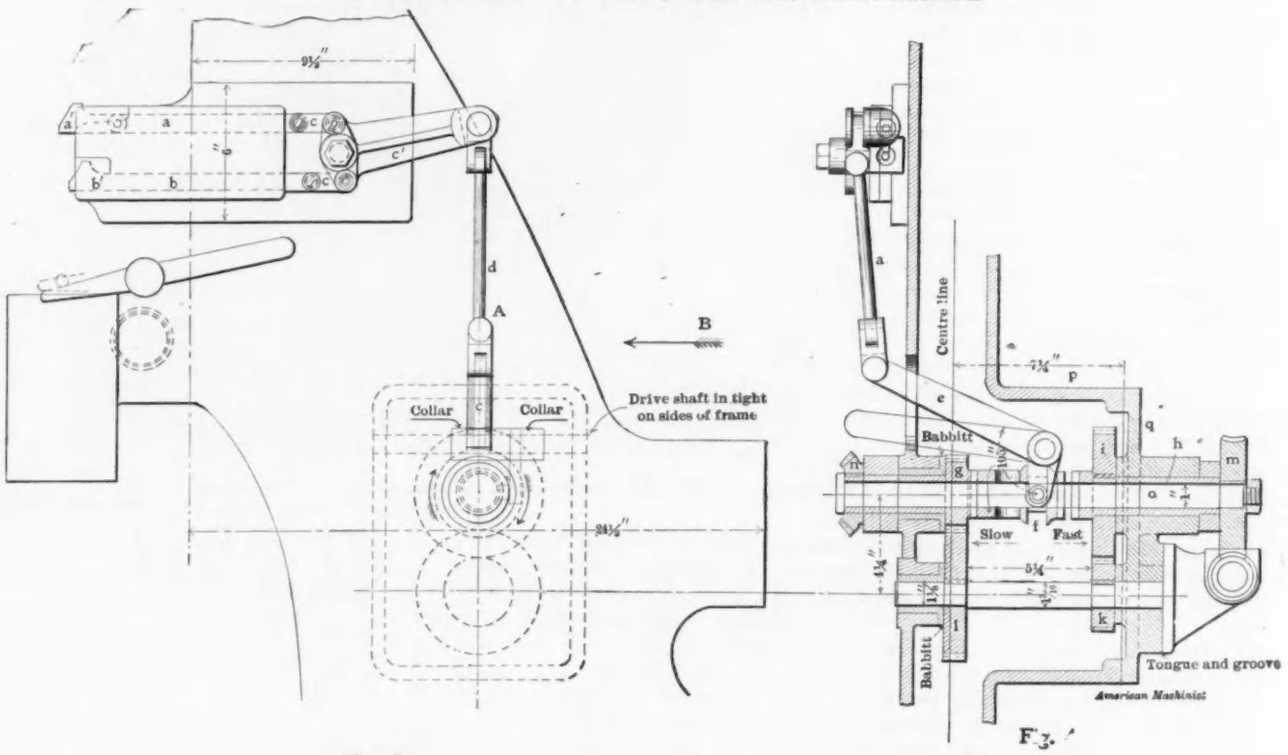


Fig. 5

FEED MECHANISM OF AUTOMATIC VARIABLE FEED DRILLING MACHINE.

An Automatic Variable-Feed Driller.

The engravings herewith presented show the general appearance and construction of a drilling machine with a feed that is not only automatic but which at a given point automatically increases to four times its normal rate and then changes back again, and proceeds until the piece of work is done, when it automatically releases.

This feature of an automatic variable feed was added to the regular drilling machine for the purpose of adapting it to a special purpose, i. e., the boring of malleable-iron hubs for the wheels of agricultural implements. These hubs have a bearing at each end, and are chambered in the middle by a core enlarged at that point. One man was to operate four machines on the job, and of course it is obvious that if he were required to release the feed, move the spindle downwards through the chamber and again throw in the feed for each piece, he would be too busy; while if the feed were allowed to run all the way through at the same rate, too many machines would be required for the given amount of work.

Referring to the drawings, Fig. 1 is a vertical side elevation of the upper portion of the machine; Fig. 2 shows the opposite side; Fig. 3 is a front elevation; Fig. 4 is a sectional view on line *A*, viewed in the direction of arrow B. The feeding mechanism is as follows:

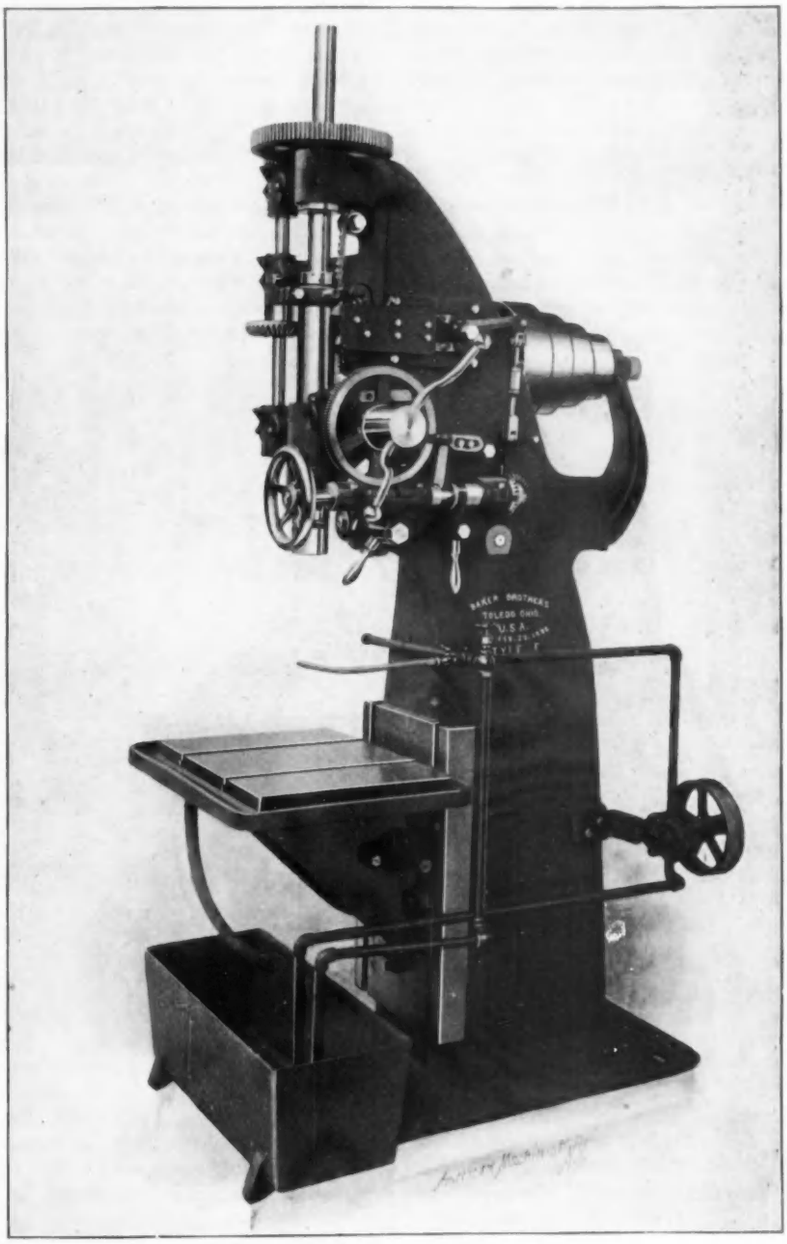
On the horizontal upper cone pulley shaft is the small, three-step cone pulley, which drives the corresponding cone pulley on the worm shaft below. On the latter shaft is a worm which drives the worm gear *m*, which is keyed to the shaft *o*. To make room for the mechanism an extension or box-like receptacle *p* is built out on the side of the frame. A removable plate or cover *q*, Figs. 2 and 4, is fitted to the extension *p*, forming a protection for the mechanism, and also having a bearing for the clutch sleeve *h*. The sleeve *h* is keyed to the spur gear *i*, and *h* also forms a bearing for the shaft *o*, which is fitted to turn freely in it. On the opposite side of the main frame is another bearing for the clutch sleeve *g*, which has at one end a pinion, forming an integral part of it. At the opposite end is keyed the miter gear *n*, and this gear meshes with a similar gear on the worm shaft *r*, Fig. 1. This latter shaft revolves in suitable bearings in the tipping frame *s*, and the worm keyed to the shaft *r* engages with the large worm gear, which is keyed directly to the stud carrying the pinion which feeds the main spindle. The lever *t* has a projection which bears against the tipping frame *s*, and when it is in position, as shown in Fig. 1, the worm is in mesh with the worm gear and the feed is going. The lever *t* is held in position by the latch *t'*, and link *t''* connects *t'* to another lever *t'''*, which is pivoted to the frame above.

When the trip collar *u* engages with the end of *t'''*, the latch *t'* is lifted and the lever *t* is allowed to fall, releasing the feed. The spindle is returned to its starting point by means of the handles on the large worm gear shaft.

Between the two clutch sleeves *g* and *h* on the shaft *o*, Fig. 4, is fitted a sliding clutch collar *f*; it is splined to *e*, so that the collar and shaft must always turn together. With this collar engaged with the clutch sleeve *g*, the normal rate of feed is obtained; but when the collar is shifted so as to engage with the sleeve *h*, then the movement is carried to the clutch sleeve *g*, through the medium of the gears *i*, *k*, *l* and *g*. The gearing is arranged so as to obtain an increase of feed equal to four times the normal feed.

On the side of the frame, Fig. 5, is secured a bracket which forms a bearing for the sliding rods *a* and *b*. Rocker arm *c'* is connected to the rods *a b* by two short links and to the bell crank *e*, Fig. 4. This bell crank throws the clutch collar *f* in either direction.

On the end of *a* is an extension *a'*, which is pivoted in such a manner that it will lift upward, but it cannot be pressed downward beyond the horizontal line. The extension on the trip collar *u* engages with the beveled edge of *a'* and forces it backward. This moves the clutch collar *f* to the right, and thus puts on the fast feed. A spring not shown in the drawing, but attached back of *c'*, assists in this movement. The spindle will now feed four times as fast as before, until the trip collar comes in contact with the sliding rod *b* (which has been thrown forward by the previous movement), and this throws the clutch collar back again and restores the



VARIABLE AUTOMATIC FEED DRILLING MACHINE.

working rate of feed. The spindle then continues to feed until the collar contacts with lever t''', when the feed is stopped automatically. The end a' attached to a is lifted by the upward movement of the collar, and by means of a spring it immediately snaps back into position ready for the operation, as described. In the machine described the total feed of the spindle is 14 inches, and the length of the intermittent rapid feed is only 2½ inches, but this can be varied to suit conditions. It is built by Baker Brothers, Toledo, Ohio.

The Mechanic in English Shops—Bullying.

A contributor to "Engineering," of London, who writes on the subject of "American Competition" and describes himself as a British workman who has spent ten years in American workshops as a journeyman, among other things says: "Americans will tell you it is the mechanics that have pushed them ahead as a nation, industrially and otherwise. Does the mechanic get any credit in England? * * * I was never spoken to uncivilly there; if there was anything to say, it was said deferentially and with consideration for my feelings. Men here are spoken to like dogs; foremen in the British Isles are simply bullies. A large proportion of them hold their positions by reason of their bullying qualities, and have often acquired these positions by intrigue and not by ability. Do employers or the lights of the industrial world think that American competition can be met in that manner? No; you have sullen and uninterested men, whom Colonel Dyer termed 'the inert mass,' though I do not accept that characterization as of universal application."

We have edited his remarks a little, as it seems to us should have been done by our contemporary, but have retained their meaning. There is a significance in them that might profitably be noted by some of our American shop managers. We all know that our English friend might easily have gotten into American shops where he would have been spoken to uncivilly by the foreman, though such shops are, of course, the exception, and fortunately so. On the other hand, it is not to be believed that all British shops are conducted as he describes them. There can be no doubt, however, but that the practice of showing contempt for workmen or their feelings is frightfully expensive, whether in England or here, to say nothing of its ethics. What the men call a "mean foreman" is the most expensive luxury a shop can indulge in. Those who continue to work for such a man secretly or openly hate him, "beat" him, or "put him in a hole" at every opportunity, while the best men usually leave as soon as possible, nearly always failing to state, as we believe they should, the real reason for their leaving. The result is that bullying and abuse seem to be more and more necessary until some day, perhaps, a decent man, who respects himself and others, takes hold of the shop and easily shows that none of it was necessary at all, and that a shop goes much better without it.

Marconi's system of space telegraphy has been introduced into the British Navy as a branch study, and a ship has been specially fitted out as a school of instruction.

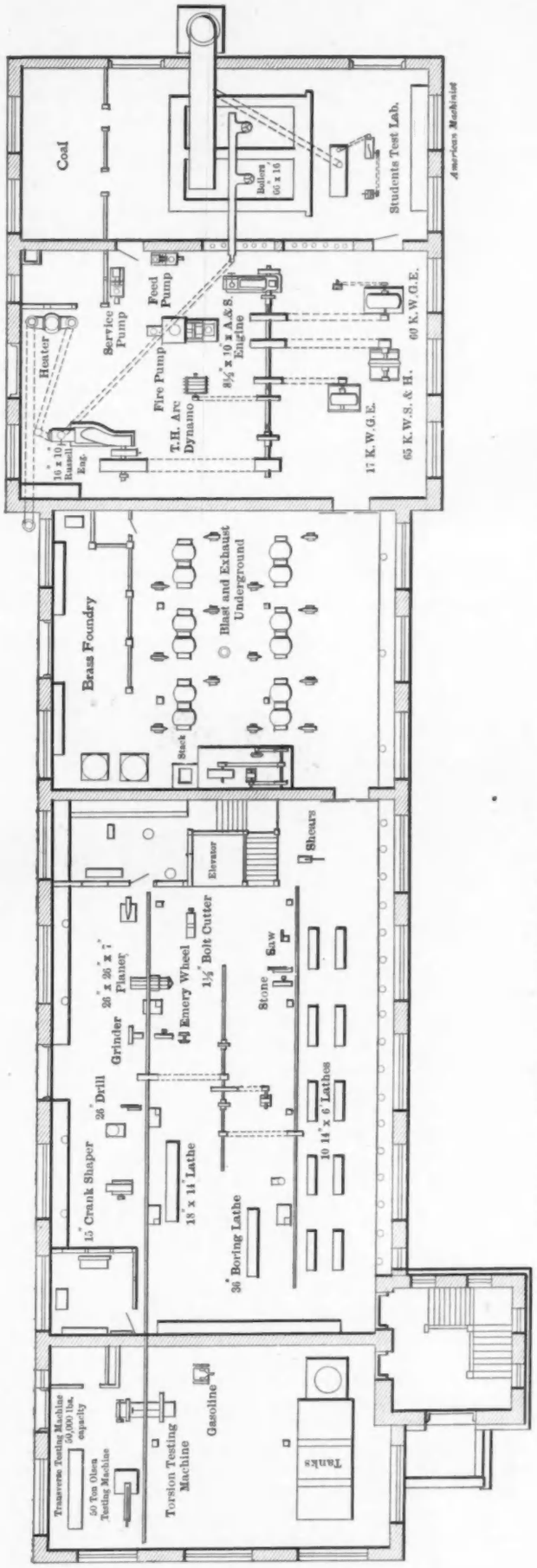
New Shops of the University of Kansas.

We give herewith photographic view and ground plan of the new Fowler shop building of the University of Kansas, which give an excellent idea of the facilities of that institution for shop instruction.

The old shops were destroyed by fire March 22, 1897, and the present outfit is the outcome of a loan of $30,000 by the citizens of Lawrence to the regents of the University in behalf of the State, and of a gift by Mr. Geo. Fowler, of Kansas City, of $21,000, from a fund set aside by his father's will for educational purposes. Some of the features of the shops will be apparent from the ground plan. Among these is a continuous row of benches along the north side of the shop. Good shipping facilities are provided by an 8-foot freight door to each of the main rooms and by the location of the road alongside and 3½ feet below the floor. There is also a 9-foot basement under the engine room, blacksmith and machine shops for pipes, wires, etc. The freight elevator runs from basement to attic. The forges are fitted with down draft, and the power distribution is electric. The University now offers a regular course of study in mechanical engineering, Professor W. K. Palmer being in charge. Professor Frank E. Ward is in charge of the shops. The shop building also serves as a central power station, sixteen electrical circuits running from the switchboard to the various buildings and laboratories.

THE FOWLER SHOPS OF THE UNIVERSITY OF KANSAS.

All the war vessels of the Russian Baltic are fired with liquid fuel.



FIRST FLOOR PLAN OF THE FOWLER SHOPS OF THE UNIVERSITY OF KANSAS—OVER ALL DIMENSIONS, 54 X 154 FEET.

Lathe Chucks and Substitute for Them.

It is a fact familiar to those who have observed the use of lathes in continental shops that the workmen there make use of removable jaws similar to our chuck jaws, which jaws are attached to the large face plate of the lathe. In some cases these are very crude affairs, being mere studs with set-screws in them, but in others they are better made and have a block which clamps to the face plate and a sliding jaw attached to this block, which jaw is adjusted by a screw. Many of our American lathe makers have been obliged to furnish some such jaw for use on the plate and to meet this demand the Skinner Chuck Company, of New Britain, Conn., is making a face plate with jaws, which face plate is threaded and attached to the lathe spindle in the ordinary way. While this is probably all right for the continental lathesman, it would occur to most American workmen, we think, that it would be far preferable to leave the jaws attached to this plate and take it off from the spindle and substitute a plain plate whenever required; the unscrewing of one plate from the spindle and putting on another one being obviously a much quicker and more convenient operation than removing or attaching four sliding jaws to a plate already on the spindle, unless the lathe is a large one. This, of course, reduces to the use of our regular lathe chucks, and that is what we think should be used, but much educational work remains to be done, apparently, before they will be generally used in continental shops.

Calorific Value of Petroleum Products.

A useful thing for those who are experimenting with various forms of oil engines to know is that petroleum and all its products possess practically the same calorific value per pound weight. The weights of the different products vary, and consequently the calorific value is not uniform per gallon, but it is uniform per unit of weight. The best authorities give the heat units in a pound of petroleum as 21,000. At 60 degrees Fahrenheit 86° Baume gasoline weighs 88.4 ounces per gallon, while kerosene weighs 104 ounces per gallon. In other words, the calorific value of a gallon of 86° gasoline is to the value of a gallon of kerosene oil as 88.4 to 104, therefore gasoline has 18 per cent. less value, gallon for gallon, for fuel purposes than kerosene oil.

The "English Mechanic and World of Science," in its latest received issue, reproduces from our columns "Jobbing Work at Goldtown," by Samuel A. Better, prefacing it with the highly amusing remark that "Useful hints are often found in places where they are not expected."

Colors of Heated Steel Corresponding to Different Degrees of Temperatures.*

BY MAUNSEL WHITE AND F. W. TAYLOR.

There is, perhaps, nothing more indefinite in the industrial treatment of steel than the so-called color temperatures, and as they are daily used by thousands of steel workers, it would seem that a few notes on the subject would prove of general interest.

The temperatures corresponding to the colors commonly used to express different heats, as published in various text books, hand books, etc., are so widely different as given by different authorities, it is impossible to draw any definite or reliable conclusion. The main trouble seems to have been in the defective apparatus used for determining the higher temperatures. The introduction of the Le Chatelier pyrometer within the last few years has placed in the hands of the scientific investigator an instrument of extreme delicacy and accuracy, which has enabled him to determine the temperatures through the whole practical range of influence, and led to the establishment of new melting and freezing points of various metals and salts, which are now accepted as the standard in all scientific investigation. There has not, however, been published any results with the La Chatelier pyrometer seeking to establish a correspondence of temperatures with color heats.

The first work done in this line, of which we are aware, is that of Dr. H. M. Howe, some eight or nine years ago. His results, however, have not been published, and with his kind permission we are enabled to give them here:

	Degrees Cent.	Degrees Fahr.
Dull red	625 to 650	1,022 to 1,157
Full cherry	700	1,292
Light red	850	1,562
Full yellow	950 to 1,000	1,742 to 1,832
Light yellow	1,050	1,922
Very light yellow	1,100	2,012
White	1,150	2,102

The nomenclature used for color heats differs with different operators, but in our investigation we have adopted that which seems more nearly to represent the actual color corresponding to the heat sought to be represented. We have found that different observers have quite a different eye for color, which leads to quite a range of temperatures covering the same color. Further, we have found that the quality or intensity of light in which color heats are observed—that is, a bright sunny day, or cloudy day, or the time of day, such as morning, afternoon, or evening, with their varying light—influence to a greater or less degree the determination of temperatures by eye.

After many tests with the Le Chatelier pyrometer, and different skilled observers working in all kinds of intensity of light, we have adopted the following nomenclature of color scale with the corresponding determined values in degrees Fahrenheit as best suited to the ordinary conditions met with in the majority of smith shops:

	Degrees.
Dark blood red, black red	990
Dark red, blood red, low red	1,050
Dark cherry red	1,175
Medium cherry red	1,250
Cherry, full red	1,375
Light cherry, bright cherry, scaling heat,* light red	1,550
Salmon, orange, free scaling heat	1,650
Light salmon, light orange	1,725
Yellow	1,825
Light yellow	1,975
White	2,200

With the advancing knowledge of, and interest in, the heat treatment of steel, the foregoing notes, it is hoped, may prove of some value to those engaged in the handling of steel at various temperatures, and lead to further and wider discussion of the subject, with a view to the better understanding and more accurate knowledge of the correct temperatures. The importance of knowing with close approximation the temperatures used in the treatment of steel cannot be over-estimated, as it holds out the surest promise of success in obtaining desired results.

This demand for more accurate temperatures must eventually lead to the use of accurate pyrometric instruments; but at present the only available instruments do not lend themselves readily to ordinary uses, and the eye of the operator must be largely depended upon; therefore, the training of the eye, by observing accurately determined temperatures, will prove of much material assistance in the regulation of temperatures which cannot be otherwise controlled.

*Presented at the New York meeting (December, 1899) of the American Society of Mechanical Engineers.

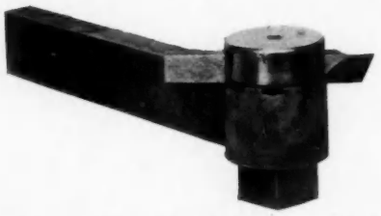
*Heat at which scale forms and adheres, *i. e.*, does not fall away from the piece when allowed to cool in air.

Tool Holders.

Tool holders, though they have long been known to some extent here, are not, we believe, so generally used as they are in Great Britain, where they do a large share of the work, even when heavy cuts are to be taken. Their advantages are, of course, that much less tool steel is used, and it is often possible, therefore, for the shop foreman who knows the great advantage of good steel to induce the purchaser of steel to get a better grade, and forging is almost, if not quite, avoided.

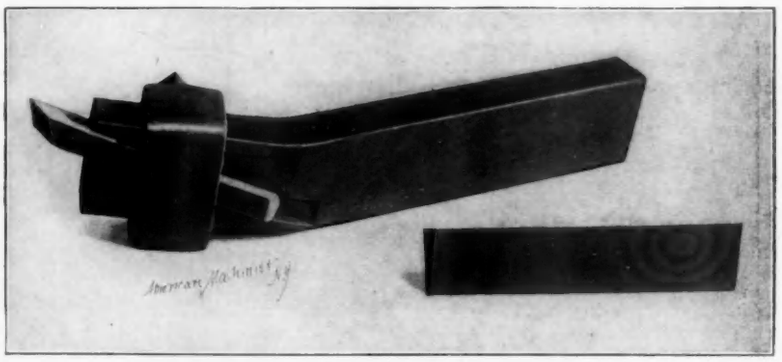
We illustrate herewith two forms of such tools that have been lately brought out.

The first of these is so arranged that a single holder is either right or left off-set or straight, the cutter passing through a square hole in a bolt which is tightened below by a nut and draws the cutter firmly into any desired notch in the top of the holder, where it is held securely. This form is made in five sizes by the Armstrong Bros. Tool Company, 106 West Washington street, Chicago.



TOOL HOLDER, BY ARMSTRONG BROS. TOOL CO.

The second holder is designed to hold either cutting off or turning tools. The stock is of steel, case-hardened, and a drop-forged and case-hardened square collar with set-screw secures the cutter in place. The holder is shown with a turning tool clamped in it, and it will be seen that the cutting off blade, when in place, fills the wider groove and covers the one in which the turning tool is held. One end of the cutting off blade is grooved for screw cutting. This holder and tool are made by the Hoggson & Pettis Manufacturing Company, New Haven, Conn.



TOOL HOLDER, BY HOGGSON & PETTIS MFG. CO.

Examination by the Board of Survey of the hollow forged propeller shaft of the U. S. S. "Helena," which was ruptured some time ago, showed the axial hole was 17-32 inch out of center, making thickness of metal on one side 1 29-32 inches, while on the opposite side it was only 17-32 inch.

Cast aluminum is about equal in strength to cast iron in tension, while under compression it is comparatively weak.

Shops of Baker Brothers, Toledo, Ohio.

When a prosperous and growing—the words are synonymous—machine manufacturing business is compelled to enlarge its quarters, and to increase and improve its facilities, it is a fortunate circumstance if this can be done by the building of an entirely new plant, rather than by changes and additions to one which has been already in existence a number of years, and which is already embarrassed with obsolete and makeshift contrivances and arrangements. A wider interest attaches probably to the designing and building of shops of moderate size than to the vast erections of the big corporations; for the building of the less pretentious and less omnivorous establishments is still most frequently indulged in. Quite a large proportion of our readers, therefore, may be expected to be interested in the establishment which we now have the pleasure of illustrating and describing. It is that of Baker Bros., of Toledo, Ohio, whose name is familiar to our readers as the builders of the Colburn keyseater, of vertical drilling and boring machines and of a few other machine tools. They have also a general business in wood-working and iron-working machinery, in electric lighting and power apparatus and in electrical supplies.

Referring to the general plan of the works, Fig. 1, the grounds comprise nearly three acres; the east side, or front, being 394 feet, the south and the north sides being 441 feet and 205 feet respectively, with an oblique line at the back. A railroad track, connecting with the Lake Shore & Michigan Southern and the Michigan Central, enters at the back of the grounds and runs through the yard between the main buildings. These comprise the machine shop, 200x80 feet, and the foundry, 260x70 feet. Attached to these as wings are a number of smaller erections, as shown in the plan, and all one story in hight. The pattern storage building, which is isolated from all the rest and upon the front line of the lot, is a two-story structure. There is room for extending the foundry on its north side and the machine shop for a considerable distance on its west end.

Fig. 2 shows the very neat office of the firm. The side wall of the machine shop, to the end of which the office is attached, is seen at the left, and the blueprinting frame will be noticed to the right. The overhanging foliage calls attention to an item in the specification for the builders which is not always thought of: "He [the carpenter contractor] will box the trunks of such trees as remain on or adjoining the premises, and see that they sustain no injuries during the prosecution of this contract." Fig. 3 is a view from the northeast, showing the pattern storage building and the east end and north side of the foundry. The buildings are of brick, with large and numerous side windows and

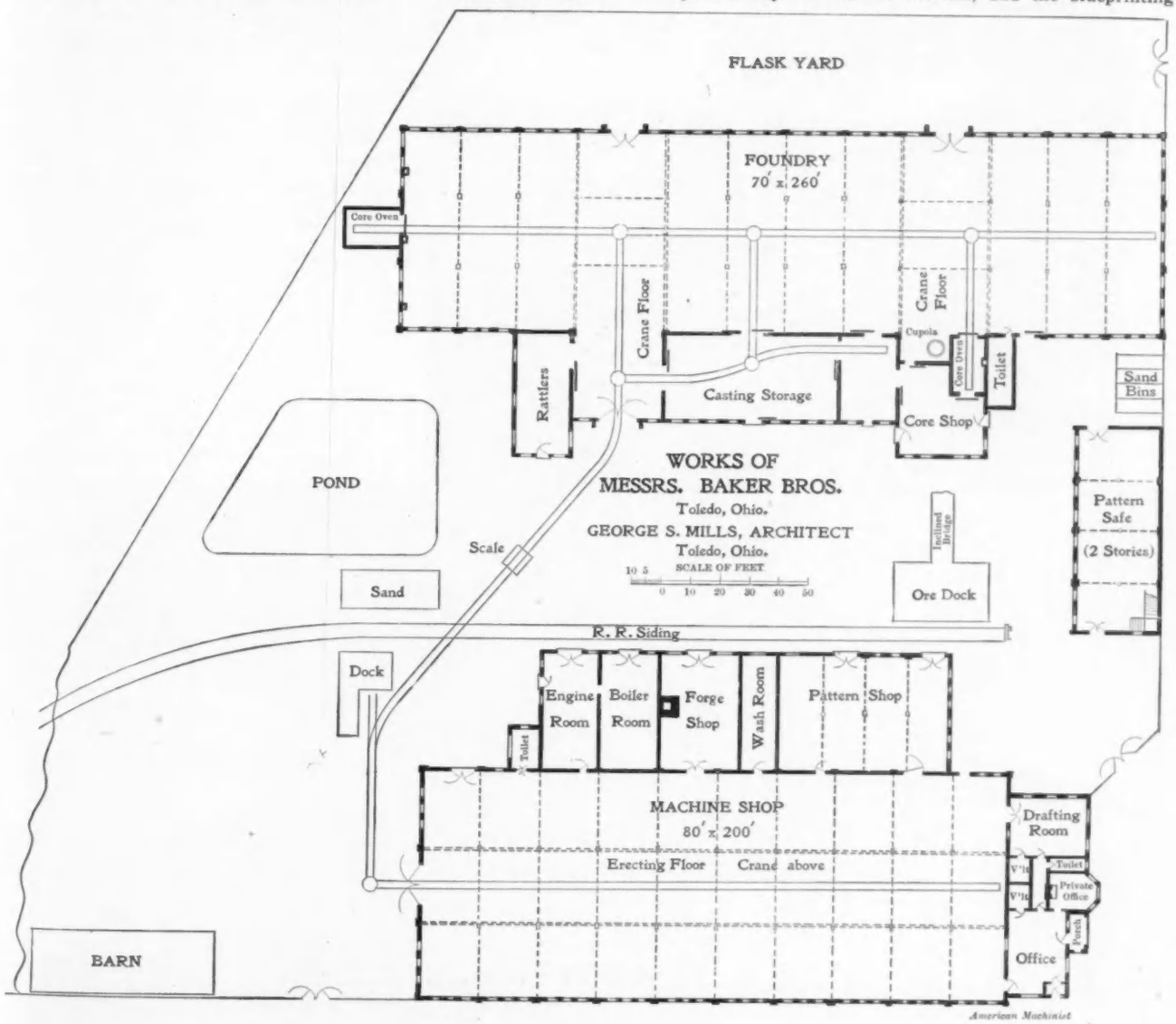


Fig. 1

GENERAL PLAN OF WORKS OF BAKER BROTHERS.

with saw-tooth roofs, the windows in which face the north. The end walls of the buildings rise to the tops of the roofs, so that the latter can be seen only from the sides of the buildings.

Fig. 4 shows the details of the roof construction, there being three sections similar to that shown running lengthwise of each building. Good provision is made for ventilation by opening the windows. The rain water is conveyed along gutters to the down spouts, which are placed at each alternate column, the water being conveyed through tile pipe to the large pond in the rear. This water is used for the boilers, and although not sufficient all the year round, it is an important and valuable portion of the supply required. A steam pipe is run along beneath the gutters, inside the buildings, for melting the ice and snow. The roof covering is hollow tile with an asphalt coating on the outside, and is absolutely fireproof. The air spaces in the tile make this a cool roof for summer. Fig. 5, which is a view from near the office end of the building, looking west through the central section, gives a good idea of the roof construction. Three hand-operated traveling cranes run on I-beams secured to the upright columns in this section. The hight from the floor to the top of the I-beam is 14 feet 1½ inches, and from the floor to the bottom of the roof truss it is 18 feet. The central section is, of course, the erecting floor, and the presence of the three traveling cranes here is worth noting. In many shops the erecting floor has but one traveling crane, and it is not an infrequent occurrence that men have to wait to get a chance to use it. This is true more partiularly where electric cranes are used. It is found here much more convenient to have the three comparatively light hand-operated cranes than to have only one large electric crane. There is one 3-ton Whiting crane, and two made in the shops of about 2 tons capacity each. For extra heavy loads two of the cranes may be used together. There are also quite a number of jib cranes fastened to the upright columns and swinging both over the erecting floor and back to the sides commanding many of the principal tools, such as planers, radial drills, big milling machines, etc. These cranes lift about 2 tons each.

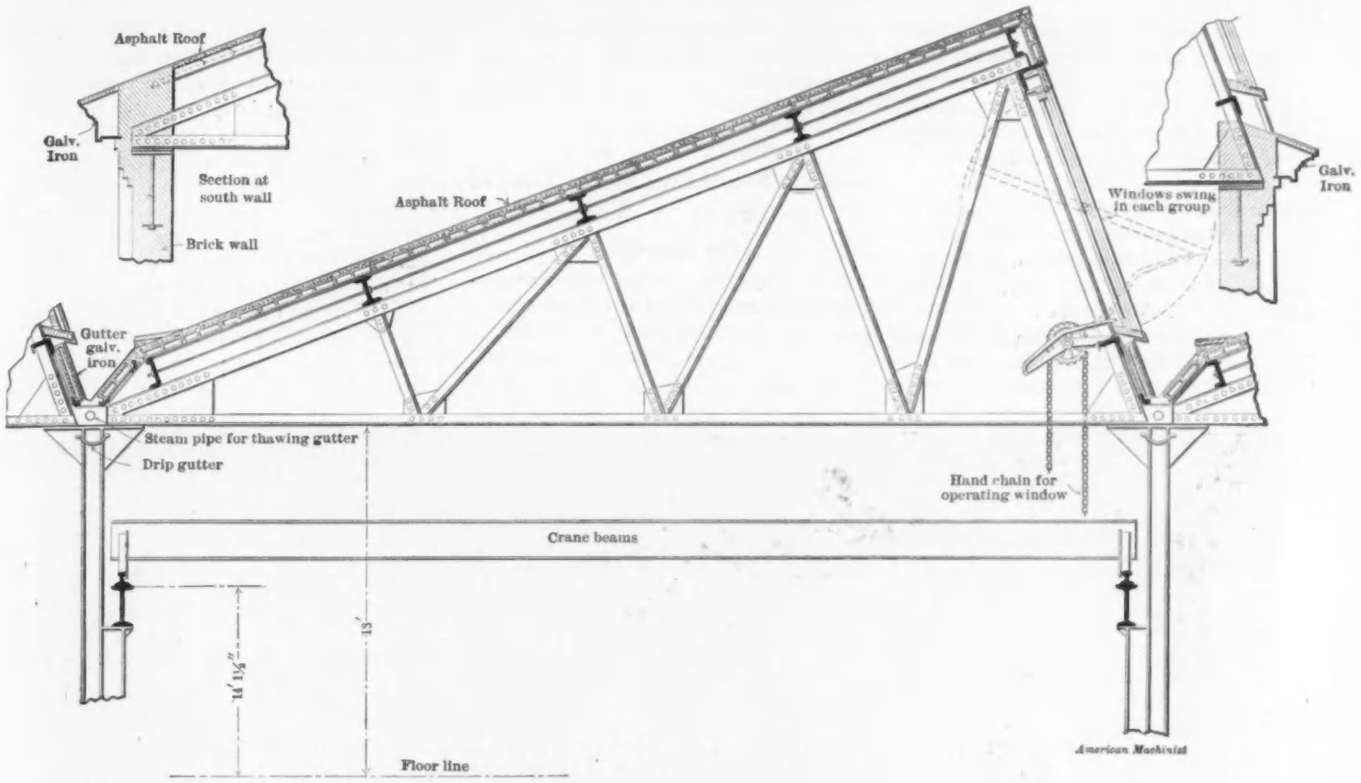
FIG. 2. OFFICE OF BAKER BROTHERS.

All heavy machines are set on special foundations built in the solid earth. The floors of the machine shop, office, pattern shop, engine and boiler room, etc., are laid on concrete. Sleepers 4x4 inches are laid in this concrete, and the floor is made of 1¾-inch matched stuff spiked to the sleepers. This makes a sufficient foundation anywhere for the average machine. Fig. 6 is another view of the central section of the machine shop, but looking in the opposite direction, or toward the office end. Fig. 7 is a view looking in the same direction along the south wall and the southern section of the shop. Here it will be noticed that the lathes and other tools are placed quite close together. The engine, as will be seen by Fig. 1, is on the north side of the building, and the carrying of the power across the crane section was something of a problem. Electric transmission was decided upon; a 65-kilowatt generator was installed in the engine room and the line shafts on this side are driven by separate motors. One of these is seen above the bench in the distance, and another is back of the point from which this view, Fig. 7, is taken. In case either motor gives out, the shafts can be coupled and driven by the other. Separate motors, are used in other parts of the plant for driving shafting or machines remote from the source of power, such as the blower, tumbling barrels, grinders, etc.

The entire equipment for the foundry is new and consists of the following: Over each crane floor is a 6-ton Whiting crane. The cupola is a No. 5 Whiting, with a No. 5 Root blower. The charging floor, 30x 40 feet, is directly above the core room, and affords ample storage for coke and iron. An inclined track or bridge runs from the pig-iron dock to the charging floor, and the iron and coke are hauled up this incline by an electrically driven Lidgerwood hoist.

The buildings throughout are nearly fireproof, there being no woodwork except window and door frames, benches, etc. The hot blast system is employed for heating the buildings, the plants for the foundry and for the machine shop being separate and distinct. The raw material for the business is brought in on the main track and distributed to the various storehouses located near it. There are a num-

FIG. 3. VIEW OF WORKS FROM THE NORTHEAST.



DETAILS OF ROOF CONSTRUCTION.

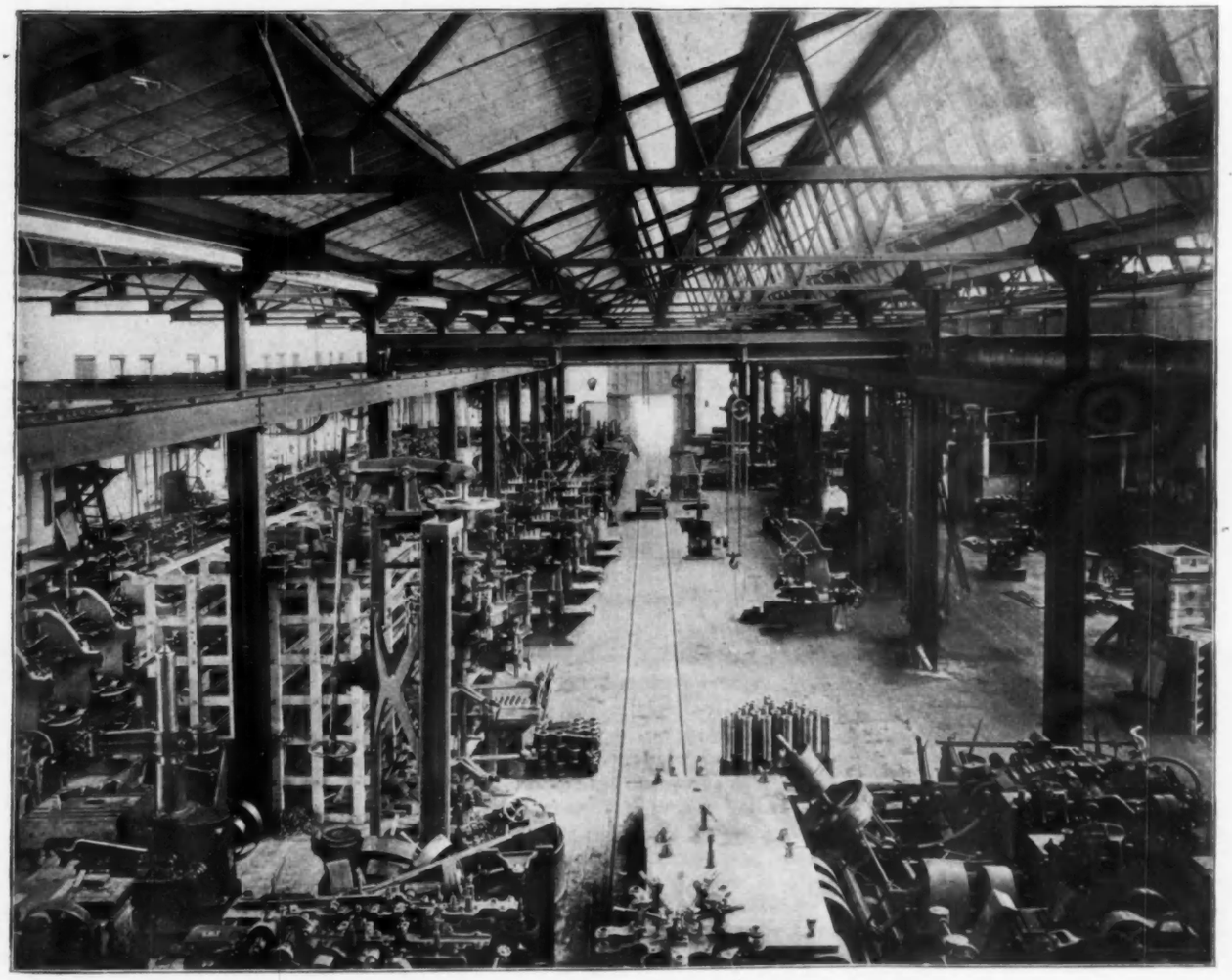


FIG. 5. CENTRAL SECTION OF MACHINE SHOP, LOOKING WEST.

ber of storage buildings in the central space and not indicated on the plan, Fig. 1. These are for coke, pig iron, sand, bar iron, etc. A narrow-gage track connects the various departments. The buildings cover between 50,000 and 60,000 square feet.

The office building is practically fireproof, having outside brick walls, hollow tile partitions and steel lathing. The ceiling and roof are made of structural iron covered with Ludovici tiles.

The architect of the entire plant was Mr. George S. Mills, of Toledo, Ohio, and the superintendent is L. H. Colburn.

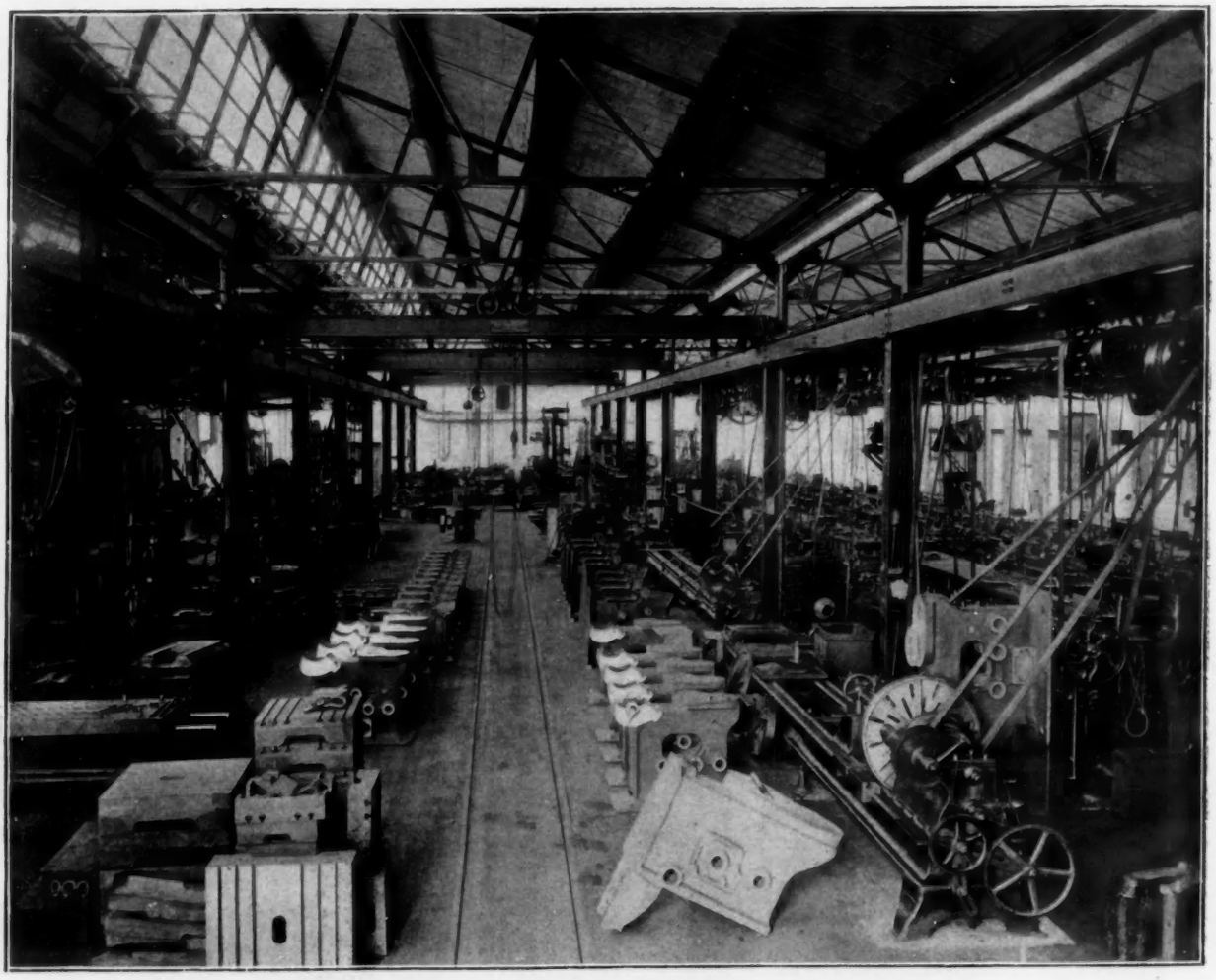


FIG. 6. CENTRAL SECTION OF MACHINE SHOP, LOOKING EAST.

A Pneumatic Letter Copying Book.

We have lately seen a novel letter-copying book which embodies in itself its own press. The covers of the book are stiff, and inside one cover is a distensible flat bag of nearly the same dimensions as the cover, and with a small projecting tube or neck near one corner. The letter to be copied is inserted in the book, the covers are secured by four locking clasps at the sides, a tube connected to an elastic bulb is screwed on to the neck of the bag, and upon compressing the bulb by hand three or four times in succession the flat bag is distended and sufficient pressure is produced to print a perfect copy of the letter. The book which we saw was not made in this country.

Should a Steam Pipe Slope Toward the Engine or Toward the Boiler?

Being asked by a reader whether medium length and long pipes leading from a boiler to various engines should incline toward the engine or toward the boiler, where a separator is used to each engine, we asked Prof. John E. Sweet to give us his opinion about it, which he does as follows:

"I think the pipe should always slope toward the engine, with no drop or sag anywhere in which water can accumulate. The reason is this: If there is even a true slope toward the boiler, at some time there will be a flow of steam just strong enough to balance the tendency of the water to flow so there will be an accumulation all along the bottom of the pipe; this, for one thing, reduces the area of the pipe, and so, even though the work on the engine be the same the velocity of flow will increase, or from a sudden increase of load the velocity of flow will increase, and this will start the body of water up the incline; this still more increases the velocity by reducing the area of the pipe; a wave is formed which soon stops up the pipe altogether, and all the water goes in a flood to the separator, and unless the separator is very large or the steam pipe short a smash-up can be expected.

"With the pipe sloping toward the engine the current of steam keeps the pipe free from accumulation. If the separator is above the boiler a drain pipe can carry the water back to the boiler, or the steam loop will do the same thing if below."

Henceforth a hundred working hours in ten days is to be the maximum exacted of any railroad employee in France, and no consecutive stretch of more than twelve hours is to be tolerated. This important reform will come into operation all over France in the course of the next two months, and, besides being an immense boon to the railway servants, should be productive of beneficial results to the public.—"The Engineer."

Engineering in the United States Navy—Its Personnel and Matériel.*

BY GEO. W. MELVILLE.

In our Society the president has the widest latitude in the choice of a subject for his annual address, and, indeed, there is scarcely an established custom as to its nature; but it always seems logical for him to choose a theme connected with the work to which his life has been devoted, and in which he is an expert. This would make my subject "Naval Engineering," and there are several reasons why it is particularly appropriate at this time. Although one other naval engineer has been president of the Society, his address had a different theme, and consequently the subject, at least as a presidential address, will be new. Moreover, this year marks a very decided change in the personnel of engineering in our navy, so that it is particularly appropriate that one of the engineers of the old school should, at the close of this chapter in the history of naval engineering, give a brief review of some of its more important facts with respect to both personnel and matériel.

Every American is naturally proud of the fact that the first successful steam vessel was the work of an American engineer; but it is not so generally known that the first steam war vessel of any navy was designed by the same American (Robert Fulton) and was built in this very city in 1814. Had the war with England lasted a little longer, there can be no doubt that the "Demologos" would have created a revolution in naval architecture; but the close of the war before she was completed rendered her active service unnecessary, and she was finally destroyed by an explosion of her magazine in 1829. The advent of the "Demologos" did not create an engineering corps nor bring any engineers into the navy, so that the real beginning of naval engineering was when the steamer "Fulton" was built, and in 1836 Mr. Charles H. Haswell, the Nestor of engineering in this country, became the first chief engineer in our navy. The "Fulton" was a small vessel of only 1,200 tons displacement, or about what would now be considered a small gunboat; but she was the beginning of what has brought about as great a change in navies as the invention of gunpowder did in warfare.

It is really wonderful to think that the man who was the first chief engineer of this first steam war vessel of our navy is still alive, in full possession of his faculties, and in the active practice of his profession to-day. One of his contemporaries some years since said that the engineer corps might consider itself very fortunate in having had for its founder such a man as Mr. Haswell, an educated gentleman and a thoroughly competent engineer. From the very first his every effort was devoted to increasing the efficiency both of the machinery and of the officers who were to care for it, and it is not going too far to say that he has left a lasting impression by his labors, the organization and scheme of examinations having long remained as he made them.

It is a little hard for the young engineers of to-day, whose training, while it may seem to them beset with difficulties in the way of intricate formulæ and abstruse calculations, is nevertheless complete, and makes them masters of an immense amount of accumulated informa-

FIG. 7. SOUTHERN SECTION OF MACHINE SHOP, LOOKING EAST.

* Presidential address delivered before the American Society of Mechanical Engineers, December 5.

tion, to realize the difficulties under which the older engineers, even of the writer's generation, and much more so of Mr. Haswell's, labored. Mr. Haswell himself was one of the first to provide a reliable book of reference for the young engineer, where the results of experience were systematically arranged; but for Mr. Haswell himself there was nothing of this sort, and he had to create the precedents. When we look at the matter in this light, we are filled with admiration for Mr. Haswell and the men of his generation at their excellent solution of the problems which confronted them.

Without going into a detailed sketch of the work done by Mr. Haswell, it may not be amiss to recall to your minds a famous old ship, the machinery for which was designed by Mr. Haswell, who, indeed, made all the drawings for it himself. This vessel was the "Powhatan," which for many years was one of the finest of our old ships and rendered most efficient service. Probably every member of this Society living near our eastern coast has seen this fine old ship. She was built in 1847, and remained in active service for forty years, a monument to those who had designed and built her.

In those early days the average deck officer of the navy did not look upon the steam engine as a desirable addition to a ship, but simply as a necessary adjunct that had to be endured. There were, of course, notable exceptions, and Captain Matthew C. Perry, the first commander of the "Fulton," was a liberal-minded man to whom engineers owe a great deal. Yet, even he hardly rose to the point of considering that engineers were a vital part of the ship's complement, and as such should be made to feel that they were as much officers as any others, and their men were just as truly sailors. Neither Mr. Haswell nor any of his assistants were regarded, when first appointed, as permanently in the navy, and the assistant engineers were removable summarily by the commandant of the station. Some years ago Passed Assistant Engineer Bennett, writing for one of the reviews, in speaking of this circumstance, expressed surprise that the deck officers should not have realized the mighty force which steam brought to them and have embraced every opportunity to take advantage of it. It seemed, on the contrary, to belong to a different world from that in which they had been trained, and instead of endeavoring to become expert engineers, they regarded the machinery and all connected with it as a disagreeable necessity and left its development to the separate corps of engineers.

Among the older engineers were many men well known to all mechanical engineers in the country, who in a quiet way did very valuable work. Time will not permit, however, of mentioning them individually in such a survey as we are making.

Some years before our civil war another great marine engineer began to attract attention—Benjamin F. Isherwood. He entered the navy in 1844, so that he is really a contemporary of Mr. Haswell. It is perhaps not exaggerating to say that he is the most brilliant marine engineer whom this country has seen, and his work has made his name known among marine engineers in all parts of the world. His fame will probably rest mainly on his record as an experimentalist, in which field there are few who have ever exceeded him, either in the amount or the excellence of the work done.

The most notable of his experiments was the series which gave the complete demonstration of the relation between cylinder condensation and the rate of expansion. Until these experiments, most engineers believed that the law of Mariotte, that the product of pressure and volume is constant, was strictly applicable to steam as well as to permanent gases, and that a very large ratio of expansion with low pressures of steam would be profitable. Isherwood's experiments on the Michigan demonstrated conclusively that under the conditions there obtaining, of a slow-moving engine and low steam pressure, a ratio of expansion was soon reached beyond which any increase would cause an absolute diminution of economy, instead of an increase thereof, as would have been predicted from a strict adherence to Mariotte's law. Every young engineer knows this thoroughly to-day, and is cautioned about it in his text-books; but so far from its being readily accepted when Isherwood's experiments had demonstrated the true facts, many will remember that he was assailed in the public prints as being guilty either of hopeless ignorance or wilful waste of the government money.

Mr. Isherwood was not only a splendid experimentalist, but a designer of the first rank, and an executive engineer who has not been surpassed. He was engineer-in-chief of the navy during the whole of the war of the rebellion, and during that time was responsible for a large number of designs. Here again he was criticised from the academic point of view, and yet the very faults for which he is criticised only appear, on proper analysis, the more praiseworthy as excellent details of sound designing. He was accused of building engines which were inordinately heavy, which accusation he has never denied. To the mere office engineer this was true, but he realized what they did not, that these engines had to go into the hands of men who were largely untrained and unfamiliar with machinery. The ordinary formulæ for design assume reasonably decent handling, and do not provide for the stresses due to ignorance and carelessness. Isherwood knew that the point of first importance was to build engines which would not break down, and, in fact, could not be injured by ignorant and careless handling. The result of this policy was engines very much heavier than would ordinarily be built; but they did not break down, and they carried our ships to victory. To my mind this was the highest proof of his talent as a sound designer. He had the courage to invite criticism from the book engineer in order that he might insure success for the country.

You all know the story of the "Alabama," and how she and her sister commerce destroyers drove our merchant marine off the ocean. The Navy Department felt it important to get a class of vessels that would be faster than the "Alabama," or any other vessel likely to be built, so that they could sweep the seas of all these commerce destroyers. A number of designers were concerned in projecting both hulls and engines to accomplish this result, but although the great Ericsson was one of his rivals, Isherwood's ships were the only ones which really accomplished what was intended. The "Wampanoag" was the first of Isherwood's ships to be tried, and she was a magnificent success in every way—really in many ways the greatest success as a steam war vessel that the world has ever known, because she distanced everything that had preceded her so much more than has ever been accomplished before or since. The "Wampanoag" was given a trial lasting 37½ consecutive hours between Sandy Hook and Cape Hatteras, and for the whole run averaged nearly 17 knots per hour. During several six-hour periods her speed was over 17 knots, and for several single hours she made over 17½. It should be noted also that this was not a smooth weather run, as the trial was ended prematurely owing to a gale, and for some time previous the weather was heavy. The speed made by the "Wampanoag" was at least 4 knots more than that of any other ship—either mercantile or naval—of her period, and, in fact, it remained the record speed for many years. Even the first fast cruisers of modern navies, like the "Esmeralda" and "Naniwa," while nominally credited with a higher speed, only made it over the measured mile, or for a short spurt, while the "Wampanoag's" record was, as stated, for more than 37 hours. Another of the Isherwood ships, the "Ammonoosuc," was given only a short trial, but showed qualities equal to those of the "Wampanoag." The best of the rival ships made a speed of about 15 knots for less than an hour, and the other vessels fell below the "Wampanoag" even more than this.

It is not perhaps generally known that in calling the "Wampanoag" an "Isherwood" ship the designation is more inclusive than might be supposed at first glance, for Mr. Isherwood was responsible for those features of the hull design which affect speed. The design of the hull as a whole was worked out by Naval Constructor Delano, an accom-

plished naval architect, but he simply took the form of hull as designed by Mr. Isherwood and worked out the structural details necessary to carry out his ideas.

It would be supposed that Isherwood's brilliant achievements would have brought him only gratitude and thanks; but, on the contrary, his vigorous methods had aroused a great many enemies, so that at the end of his second term as Chief of the Bureau of Steam Enginering there was sufficient influence to prevent his reappointment to the office which he had so well filled, and he was banished to the Mare Island Navy Yard. But this only gave him an opportunity for some of his best experimental work, and the famous propeller experiments, which are still a mine of valuable information for designers, were conducted there with the assistance of Mr. William R. Eckart, a former engineer of the navy and an honored member of this Society.

After these experiments, and until his retirement, Mr. Isherwood conducted many others which have given valuable information to engineers, and it may be well in passing to remark that his reports of experiments are models to which all young engineers can refer with great profit to themselves. The thoroughness with which the apparatus under experiment is described and its dimensions given, the elegance and lucidity of the language, and the admirable arrangement, are all models of what such a report should be, just as Macaulay's style is so justly commended to all young writers.

From a remark which has just been made as to the qualifications of many of the engineers who came into the navy during the war of the rebellion, it might perhaps be inferred that there were few men of real ability; but this would be unwarranted, and would be an entire mistake. The total number of engineers was so large that it was utterly impossible to have even a majority of them skilled men; but a number of talented young engineers came into the service, and the profession generally has learned to recognize their ability from the fact that in the years since the close of the war a large proportion of the leaders in mechanical engineering in our country are men who were naval engineers during the war. The first president of this Society (Dr. Thurston), as well as the second (Dr. Leavitt), were naval engineers, and so was that other able man, Charles E. Emery, now gone to his long rest. William Everett, who became famous in connection with the laying of the first Atlantic cable, was another, and so was George Westinghouse, whose wonderful achievements, both as an inventor and as the creator of great industrial works, entitle him to be called the Napoleon of industrial engineering. Theodore Cooper, the great bridge engineer, and Lay, the inventor of the automobile torpedo, were naval engineers during the war. We must also call attention in passing to Chief Engineers Alban C. Stimers and Isaac Newton, who brought the original "Monitor" down to Hampton Roads and enabled her to whip the "Merrimac." But for their ability and indefatigable labors the results would have been very different. We might also recite case after case of gallantry and daring where vessels were saved by the skill of the engineers; where they lost their lives through attention to duty, or where they distinguished themselves specially in other ways, but time will not permit us to dwell upon these features.

During all the period which we have thus far considered, the engineers for the navy had obtained their education outside of naval influence; but in 1866 a class of young men was ordered to the Naval Academy to be trained as engineers in a naval atmosphere. A number of these gentlemen are still in the service, and were chief engineers of our large vessels during the recent war with Spain. In 1871 engineer cadets were appointed for the Naval Academy, the course being for two years only, until in 1874 a class was appointed whose course was to be for four years.

These young men were appointed by competitive examination open to the whole country, and as the course became better known the numbers who came to compete increased, and their attainments became so high that an unusually able class of young men was obtained as cadet engineers. Unfortunately for the service, Congress was seized with one of its periodical fits of retrenchment, and as no patronage was affected by abolishing the cadet engineer system, the separate course for engineers was wiped out in 1882, and for a time engineering education dropped out of the curriculum at the Naval Academy.

It is probably safe to say that the young men graduated from the Naval Academy under the cadet engineering system presented a higher average ability than any equal number of young men from any of our great technical schools; indeed, so great was their ability that the service was unable to retain them, but the country has profited from the training they received by their work in civil life. A number are filling positions as professors of mechanical engineering in our leading colleges; a number are consulting engineers of the highest rank, and several are engaged in the management of our large manufacturing enterprises—one (who is vice-president of this Society) being the general manager of one of the largest electric companies in the world. It is a peculiar pleasure to me to bear tribute to the talents of these young men, because a great many of them have served as my assistants in the Bureau of Steam Engineering, and while I am naturally filled with regret that the navy should lose their services, I also feel proud that my own judgment in estimating their ability should be so thoroughly confirmed by the esteem in which they are held by engineers outside of the navy. I would not have it supposed from my remarks about those who have left the service that they took all the ability with them. Some of the most useful and accomplished officers, graduates and non-graduates, are still in the service, which I trust will be able to retain them.

In this connection, too, it is only right that I should bear testimony to the worth of the men who, at the Naval Academy, trained these young engineers. One of the earliest of the instructors was Dr. Thurston, the first president of this society, whose fame as an educator is world wide; but there were others who, while not so well known, nevertheless did splendid work. Just as I remarked at an earlier point about the work of Mr. Haswell and others as pioneers, so it is with these early instructors in engineering at the Naval Academy, who had practically no text-books, and who were compelled, in the professional part of the instruction, to depend almost entirely on their own experience; further than this, they had nothing to guide them in the way of a curriculum, and they were compelled to establish one tentatively and develop it as experience dictated.

Curiously enough, just about the time when Congress was undoing the splendid engineering work at the Naval Academy, the Navy Department itself was formulating plans for vessels which should be designed along lines so different from those which had preceded that the familiar epithet applied to them—the "new navy"—is entirely appropriate. The labors of the first advisory board made available a mass of information, as a result of which Congress in 1883 authorized the building of four Roach cruisers, which were the beginning of the new navy. These vessels, I may say in passing, although possessing few features of novelty, as far as marine engineering in general is concerned, were nevertheless a marked change from the old wooden ships which had preceded them, and they rendered very valuable service, and are still, with modernized machinery, very satisfactory and useful vessels.

In 1885, when Mr. Whitney became Secretary of the Navy, there was inaugurated a period of great activity and progress in the Navy Department, taking what had been done by Secretary Chandler, who started the new navy, and carrying on the work along the lines of logical development. Mr. Whitney's determination was to have ships which should be fully the equals of those in any country, and it was through him that the speaker was called to the position of Engineer-in-Chief of the navy in 1887, succeeding his life-long friend, Commodore Loring, one of our past presidents, whose reputation as an engineer is too well known to all of you to need any praise from me.

I desire, in this connection, to say that no head of an office has ever been more

fortunate in the young men who have been his assistants. No one has ever had the co-operation of abler men, and this has always been rendered with a loyalty and cordiality which deserve all the praise I can give, and I say with perfect frankness that if the progress of naval engineering in our country has been great during the past twelve years, it is due, in a large measure, to the cordial assistance of the talented young men who have worked with me.

I believe it is generally admitted that the machinery of our navy has been in all respects fully abreast of the latest developments, and in many respects we have taken the lead. One of the first things which may be mentioned is the fact that during the period before water tube boilers were used in any navy, and when in some foreign navies there was a great deal of trouble with the shell boilers, due to the effort to get an abnormally large amount of work out of them, we had no such trouble. We believed in the principle of never sending a boy to do a man's work, and as a result we never had a boiler incapacitated through leaky tubes, and never lost a trial trip on this account, while failures of this sort were very common things abroad.

One of the first things we did was to establish the use of water tube boilers and light compound engines for our steam launches. Private builders in this country had used water tube boilers, but the results, owing to the type of boiler employed, were not altogether fortunate. We found a boiler which has proved entirely satisfactory, and also developed light machinery which was also sufficiently substantial to stand the comparatively rough handling with which the machinery of small boats must inevitably meet. We are to-day the only navy in the world which uses water tube boilers exclusively in its small boats. When we started, the effort was made to save as much water as possible, and small blowers run at high speed were used for draft, but the inevitable hum caused so many objections to be entered by officers of high rank that we were driven to the use of the steam jet. It was, of course, important that the most economical form of jet should be used, but when we came to determine this question we found that there were absolutely no reliable data in existence. As a result, we carried out a valuable series of experiments at the New York Navy Yard, and found an exceedingly simple form of jet, which was also very economical, giving us a fairly high rate of combustion for a comparatively small expenditure of steam.

It was evident to us that with the prevailing tendency toward continual increase of speed and power, with the accompanying increase of steam pressure, the shell boiler would at some near date have to be superseded by the much lighter water tube boiler, and we therefore invited a competition among the various manufacturers of water tube boilers, with a view to determining the one which, all things considered, would be best adapted to naval uses. Although this competition occurred about ten years ago, you are doubtless familiar with the circumstances, and that, as a result, we installed about 5,000 horse-power of Ward boilers in the coast defense vessel "Monterey," this being at the time, and for several years, the largest installation of water tube boilers in any naval vessel. I am glad to say that these boilers have always given satisfaction and are still in use. At this same time water tube boilers of a different type were installed on one of our torpedo boats, and we have never used any other than water tube boilers on any of the numerous torpedo vessels which have been built since.

It would have been an easy matter, and it would have brought temporary praise to the Engineer-in-Chief, if, after the successful trial of the "Monterey," we had at once launched out into the use of water tube boilers for all our vessels; but we felt that there had not been sufficient experience in their use to warrant us in making such an experiment in our first sea-going armorclads, and consequently, for a number of years, and even after foreign navies had begun to use water tube boilers extensively, we continued to use the shell boilers in our large vessels. Two years ago, when I felt that there had been sufficient experience to warrant us in the final adoption of water tube boilers, I recommended in my annual report to the Secretary of the Navy that we should definitely adopt water tube boilers for all classes of vessels. For reasons altogether apart from the machinery, we were not at first successful in securing water tube boilers in the department's own designs in spite of my urgent recommendation, but the firms which tendered on the government's designs also offered to guarantee higher speeds if they were allowed to use water tube boilers and more powerful machinery in hulls of their own design. This I had advocated very strongly, and both the technical and daily press of the country had supported this position very heartily, believing that it would be a woful mistake for our country to build sixteen-knot battleships when the rest of the world were building ones to make eighteen knots, and when by the use of water tube boilers we could so readily do it. I am glad to say that the department accepted the builders' offer, thus definitely adopting water tube boilers and securing the eighteen-knot battleships for which I had worked so hard. At the present time all our new designs include water tube boilers exclusively.

One of the notable improvements in design which we introduced for large vessels was the use of triple instead of twin screws. We were not the originators of this method, as small vessels in both France and Italy had demonstrated its success, and both France and Germany were building vessels of about 12,000 horse-power with this system of propulsion. When it came to the design of the "Columbia," the first of our commerce destroyers, with 21,000 horse-power, I was satisfied, after careful study of the problem, that we would need to use triple screws to attain success. At the beginning I did not anticipate an economy in propulsion, and the adoption of triple screws was for structural reasons; but when the "Columbia's" trial occurred we found that there was a material increase in the propulsive efficiency. When the "Minneapolis" was tried shortly afterward with the same system of machinery, this fact of greater economy was again established, so that we now feel that triple screws are justified not only for numerous other reasons, but on the ground of economy. This arrangement of propellers has become very popular in a number of foreign navies which have followed it out on a considerable scale, and have built all their large vessels with triple screws. It is probable that we shall do the same thing in our larger ships of the new programme.

During our late war with Spain we developed and utilized two engineering schemes which had never previously been tried in actual service—a repair ship and a distilling ship. The former is one phase of the modern method of treating large work by taking the tool to the work instead of bringing the work to the tool. The "Vulcan" was the equal of anything except a very large repair yard, and after the battle of Santiago she was almost invaluable in the much needed general overhaul of all the ships. Besides an admirable outfit of machine tools and engineering stores, the "Vulcan" was specially notable for using the first cupola ever installed on board ship. The distilling ship was fitted with a four-unit, triple-effect distilling apparatus capable of furnishing 50,000 gallons of fresh water per diem after use for some time with an economy of over 20 pounds of water per pound of coal burned under the boilers. With clean coils the "Iris" actually furnished over 100,000 gallons per diem. The bunker capacity is 3,000 tons of coal, thus giving a potential capacity of distilled water of 60,000 tons, or as much as twelve of the largest tank steamers. The advantages of a distilling ship over a "tanker" are very numerous and obvious.

The war with Spain was too short to give a chance for great experience in any line, but the work of the "Oregon" stands out as a brilliant illustration of the fact that the modern battleship is not only the creature of the engineer, but is absolutely dependent upon him for success. You all know the story of Milligan's work as the chief engineer of the "Oregon"; of his ceaseless vigilance to keep everything in order and prevent any deterioration; of how he saved the good coal for the day of battle which finally came (though he was told it never could come), and, above all,

how he persuaded Clark, the commanding officer, to have *all* the boilers ready all the time, although others had steam on only half the boilers and, where it could be done, half the engine power was laid off. I am firmly convinced that the brilliancy of the victory at Santiago is largely due to Milligan's skill and foresight, and, as I said, this case is direct proof that however admirable as a great fighting machine, the battleship is useless except in the hands of trained engineers.

During the last fifteen years naval engineering has shared in the general progress of all marine engineering, and has led in many respects. Wrought iron, which was formerly the mainstay of the designer, has practically disappeared, to be succeeded by mild steel, which is not only stronger but much more reliable, and the manufacture and inspection of which has been brought almost to perfection. There is little doubt that the great improvements which have been made in both engines and boilers would have been impossible but for the greatly improved material. One of the greatest improvements has been in the reduction of weight of machinery, and this has been due both to improved material and to radical changes in design.

In the engine there has been a better disposition of the material; and the use of hollow instead of solid shafting and other large pieces of forged material, the use of steel castings, etc., has been instrumental in enabling the use of higher pressures, and particularly of higher rotative speeds. These rotative speeds have become possible since we have learned to design the propellers on rational principles. In the old days, as you are well aware, the rule was to make a propeller as large as possible, consistent with immersion, and this, on account of the empirical rules for the ratio of pitch to diameter, necessarily kept down engine speeds. Now we know that within reasonable limits we can design a propeller to suit almost any engine speed; consequently, we are left free to adopt as high a rotative speed as is desirable and consistent with safety, a sured that we can afterward design an economical propeller to fit it.

In the boilers, the reduction of weight has been due, apart from the more recent adoption of the water tube type, to improved material, and especially to forced draught. This, as you are doubtless aware, is an American invention almost contemporaneous with Fulton's early steamers; but it had almost disappeared, and after a brief revival under Isherwood during the civil war, had again died out until it was taken up in some of the foreign navies. At the present time no naval machinery is ever designed without the use of forced draught.

Pressures have been gradually rising, and even with shell boilers as high a pressure as 200 pounds has been employed; but with the present plans of using 250 pounds at the engine, with either triple or quadruple expansion, and some 25 or 50 pounds more at the boilers, nothing but the water tube boiler would do.

At the present time it seems as though we had practically reached the highest development possible with existing types of machinery for naval purposes, leaving the designer room only for greater perfection in details. We do not, of course, believe that finality has actually been reached, and it is possible that some radical change may take place which will give us a new type of machinery. Some of the more enthusiastic members of the profession think that the steam turbine is to be the successor of the present steam engine, and assuredly the performance of Parsons' "Turbinia" is sufficiently remarkable to justify the most careful study and further experiment. It is very interesting in this connection to know that in this country the development of the steam turbine is in the hands of one of our famous engineers, who is also one of the honorary members of this Society—Mr. George Westinghouse. He has been developing the steam turbine with special reference to its use in driving electric generators, and some of the results already obtained are very remarkable. With his characteristic energy and courage, he is not satisfied with results on a small scale, but is now getting out a steam turbine to develop about 2,000 horse-power on a single shaft, and when this has been built and thoroughly tested we shall be in a position to appreciate more thoroughly the bearing of this form of prime mover on naval engineering.

At the beginning of this address it was remarked that this was a peculiarly appropriate time for discussing the personnel of naval engineering, on account of the radical change which took place this year in the status of the engineer officers of our navy. For many years, as you all know, there had been an unfortunate controversy in our navy, known as the "line and staff fight," resulting from the fact that the line officers, as the older organization, were unwilling that the staff, and especially the engineers, should have all the rights to which the latter believed themselves, as naval officers, entitled. The great grievance of the engineers was that they held what was called "relative rank" and were denied the command of their men and a military title, so that there was always room for the statement, which unfortunately was made at times, that they were not really officers and had only a *quasi* rank. All men who have passed middle age have probably realized personally the difficulty of bringing about any radical change in existing conditions of long standing, and I really believe that the trouble in the navy was largely a matter of inertia. An enormous amount of valuable effort was wasted on both sides; the one to secure the coveted rights, the other to prevent this result; but matters had been shaping themselves for a considerable time so as to make a new state of affairs inevitable. The change in the means of offence on board ship had brought the line officer to the point of realizing that he must, of necessity, be a good deal of an engineer, and such work as the manufacture of guns, which is, of course, purely mechanical engineering, showed this very strongly. On the other hand, the work of the naval engineer on board ship, which had originally been to direct a very few men with small machinery, has been gradually changing, until, on some of our large ships, the chief engineer commanded in fact, although not in name, about half the crew; consequently, his duties had become very largely executive and military, and thus of the same nature as the duties of the line officer. As a result of this state of affairs, many of the more liberal minds on both sides believed that the solution of the vexed question in the navy was the consolidation of the line and engineer corps, and making the new line officer an engineer as well as a sea warrior, or, as Congressman Foss expressed it, a "Fighting Engineer."

A board of naval officers, presided over by Colonel Roosevelt, then Assistant Secretary of the Navy, finally formulated a scheme for carrying out this idea of amalgamation, which was actually proposed in the board by a line officer (Captain Evans). When it was submitted to Congress two members of the House Naval Committee, Hon. George E. Foss and Hon. A. G. Dayton, took up the measure very actively, and with the assistance of other members of the committee, pushed it forward to complete success, until the Personnel Bill became a law, March 3, 1899.

Under the provisions of this law the officers of the Engineer Corps were transferred to the line and given new commissions as line officers with *actual* rank, thus effectually disposing of the phantom of *relative* rank. I wish particularly to emphasize the fact that the basis of the law, and the consideration that led to its adoption, was the demonstrated fact that to have a successful navy every line officer must be a thorough engineer. This was very well phrased by Colonel Roosevelt in his report of the findings of the Personnel Board, where he said "every officer on a modern war vessel, whether he wants to or not, must in reality be an engineer." Mr. Foss, in his report to the House recommending the passage of the bill, used language of the same import, and elaborated the matter still further, and in the speeches on the floor of the House this was the subject which had most weight, and which brought about the passage of the measure.

A natural inquiry on your part will be, how successful is this measure in actual practice? To this the answer is that any such change must, of necessity, require time, and it is too early yet to speak of results. I wish, however, to put on record my opinion that if the administrative

details necessary to carry the law into effect are worked out with an honest desire to give due effect to its plain intent, and with a desire to make it a success, the results will be all that can be wished, and we shall have the most efficient navy in the world. If, through any unfortunate combination of circumstances, which, however, I can hardly believe possible, there should be any temporary indifference or opposition on the part of those in authority, the result can only be lack of efficiency and disaster in case of war until the intent of the Personnel Board and Congress is put into working effect.

It may occur to some who have only looked into the matter hastily that this scheme of amalgamation is contrary to the spirit of the age, with its tendency toward specialization; but, as an actual fact, the reverse is true. The misapprehension comes from a failure to thoroughly consider the case. When it is proposed to make every naval officer an engineer, we mean an engineer specially fitted for the work to be done in the navy, just as the other training of the line officer is for the duties which come specially to him; in other words, this new line officer—the "fighting engineer"—is to be a specialist in the very best sense of the term; that is, a man who has been specially and thoroughly trained for the work he has to do.

I think we may all feel a pardonable pride in this change in the status of our naval engineers. The amalgamation is analogous to that which occurred in the British navy just after Cromwell's time, and the analogy is not a fanciful nor forced one, but is strictly accurate. Up to the time of that change, naval vessels were manned by soldiers who did the actual hand-to-hand fighting, but were entirely ignorant of seamanship, and another set of men who managed the propulsive power of the vessel, which was then the wind acting on the sails, and who directed the movements of the vessel. These men had no military rank, and were designated simply by professional titles, being known as "the sailing master and his mates." The amalgamation which then occurred was of the soldier and the sailor, and out of this amalgamation was evolved the man-of-warsman and the naval officer. With the advent of mastless ships, we had reached an analogous condition where one set of people fought the guns and another set managed the propulsive power, this time steam acting through machinery. The new amalgamation has made a new naval officer, "the fighting engineer," to be followed in time by the successor to the old man-of-warsman, who will be the "fighting mechanic." The basis of the new amalgamation is the fact that in this industrial age engineering and mechanical skill are the source of efficiency in our navy, and this, as I have said, is a pardonable cause of pride to all of us as engineers.

In the past, engineering has been hampered at times in our navy on account of the subordinate position which its representatives held in the naval organization; but in the future, as the whole body of naval officers will be engineers, we have every reason to anticipate an era of progress and efficiency greater than has ever been known in the history of navies.

This address has grown to a length which I hardly anticipated when I began, and for which I ask your indulgence, trusting you will agree with me that the importance of the subject and the opportunities of the occasion excuse the extent of the address. We of the old school have lived to see our fondest hopes realized in the proper recognition of our beloved profession before we have actually ceased to participate in its active work. We linger with fond memory over our trials and discouragements, as well as our successes, and we may, perhaps, realize that some of our successes have been due to the stimulus of opposition; nevertheless, it does not make for success that when one is honestly doing his best work he should feel that much of it may be in vain on account of senseless opposition and failure on the part of those in high places to appreciate it; and as we older men leave the scene of action and pass on our work to the younger generation, we can congratulate them heartily on starting out under circumstances which are so infinitely better than those of our time, and which give them so much greater opportunity for highly efficient work for the republic.

I thank you very sincerely for your patience in listening to this long address, and also for the kind consideration which you have all shown me during my term of office as president. I wish also to express my gratitude to those who have been office bearers with me for their co-operation, and particularly to our most efficient secretary, Professor Hutton, to whom the Society and every president owes so much.

The Twentieth Annual Meeting of The American Society of Mechanical Engineers.

The evening of Tuesday, December 5, saw the members gathering in the Society house in numbers which indicated a record-breaking attendance. The house was uncomfortably crowded at an early hour, and at 9 o'clock, when President Melville's gavel called the members to order, the convention hall was too small to hold those present. After an hour or more of greetings and handshakings the call to order was given and the president's annual address was delivered, the title being "Engineering in the United States Navy." The address was partly historical and partly biographical; it sketched the rise and growth of the steam engineering department of the navy, with the growth of steam propulsion, and gave many interesting facts regarding the speaker's predecessors in his high office, as well as of their more notable vessels, many of which have almost faded from the memory of the general public. The conclusion of the address was devoted to the radical change which has recently taken place in the status of the engineer officers of the navy. This meets the distinguished author's entire approval, provided "the administrative details necessary to carry the law into effect are worked out with an honest desire to give due effect to its plain intent." If this is done, the author believes that "we shall have the most efficient navy in the world." The address is one of the best of its kind in the society's annals. It was listened to with close attention, and at the conclusion received a hearty round of applause.

As the conclusion of the address the secretary announced the gift to the society, from Miss Cornelia J. Carrl, of a signed brush drawing by the hand of Robert Fulton, which bears an autographic signature with the date 1797. The drawing was placed on view on an easel in the auditorium.

WEDNESDAY MORNING SESSION.

The business meeting of Wednesday morning was opened by the reading of the Annual Report of the Council, which does not need to be detailed here, further than to say that the financial position of the society is by it shown to be excellent. It should also be noted that the report records the transfer to the society's possession of the late Mr. W. F. Durfee's valuable library, which is composed largely of rare antiquities.

The reports of committees being called for, the Committee on a Standard Method of Conducting Steam Engine Trials reported progress.

The Committee on the Provision of a Suitable Memorial to Robert Fulton reported that $925 had been already subscribed, although the subscription list had been open for ten days only. The authorities of Trinity Church cemetery, where Fulton's remains lie, as well as Fulton's descendants, had shown the most hearty spirit of co-operation in the matter, and there seemed to be no doubt about the success of the undertaking.

The Committee on Standard Generator Sets reported progress. The committee had found a hearty spirit of co-operation on the part of both the American Institute of Electrical Engineers and the various manufacturers, and the prospect for a suitable set of standard dimensions being eventually adopted is excellent.

The "Report of the Committee on the Revision of the Society Code of 1885, Relative to a Standard Method of Conducting Steam Boiler Trials" was then received.

The discussion of this report in preliminary form has been a regular feature of the meetings of the society for some time. The various suggestions made by the membership have been duly considered by

the committee, and where deemed advisable have been incorporated in the report.

There was no further discussion of this report. It was accepted and its use recommended, and some very appreciative remarks regarding the value of the labors of the committee were made, which are more than deserved. This has undoubtedly been the most laborious piece of committee work ever done for the society.

The report on the junior meetings stated that the attendance had been very gratifying and that the meetings seemed to be well established. It has been found, however, that there is a larger participation by the older members than was contemplated at the start.

The tellers of election reported the election of Mr. C. H. Morgan as president, together with the others of the regular slate to their respective offices. The retiring president then appointed Mr. Fritz and Col. Meyer a committee to escort the new president to the platform, where he made a few brief remarks expressing his gratitude at the honor conferred upon him.

The committee which had been appointed to canvass the membership regarding their intentions to visit Europe next year in a body, reported that, up to date, 511 had signified their intention to go. Further, it appears that no existing steamer can take such a party, and that nearly all available passage on many lines of steamers has already been engaged. But one line had tendered a proposition to take the party. Under these circumstances, those expecting to go must make their arrangements at once.

Under the head of new business, Col. Meyer referred to the society standard of 1894 for pipe flanges. The manufacturers had found it necessary to depart from this and he moved the reappointment of the old committee to reconsider the subject, which motion was carried.

Notices regarding the various excursions were then read, and the reading of papers was taken up. The first to be considered was:

The Steam Engine at the End of the Nineteenth Century.*

BY R. H. THURSTON.

This paper is a description with an analysis of the results of a test of a pumping engine owned by the Pennsylvania Water Company, located near Pittsburgh, Pa., built by the Nordberg Manufacturing Company and designed by B. V. Nordberg. This engine having shown the highest duty on record, is very appropriately taken by Dr. Thurston as the text of a review of the progress of the steam engine in the matter of duty during the century. Incorporated in the paper is a reprint of a diagram showing graphically the rise in duty during the century, the Nordberg engine representing the culmination. This curve was first published some years ago, but was extended as a piece of prophecy to the year 1900, and it is most curious to note how closely the facts bear out the prophecy. The paper closes with the following statement of the present outlook:

"The curves of progress which the writer has presented here and elsewhere are seen to cover the whole period, and, even though constructed some years before the end of the century, to represent with practical accuracy the path of improvement to its close. The twentieth century will very probably see a change in the curve of our lines, if not, in some respects, a decided halt or a reversed curvature, and it is perhaps even more probable that the field of the steam engine will become greatly restricted by the introduction of other heat motors, as well as by the general employment of electricity as a medium of extensive power distribution from hydraulic and pneumatic prime movers. The steam engine has now been so far perfected, and the practical limits of pressure are coming to be so nearly approached by steam boiler constructers and users, that but little more can be expected of the designer; and, even with the costlier types of engine, practically justifiable with exceptionally high costs of fuel, uninterrupted working and low values of money, as in some instances with the steam pumping engine, commercially practicable progress seems likely to prove very slow henceforth. These costly types of engine must necessarily have a comparatively narrow field. With the common case of moderate cost of fuel, intermittent duty, comparatively high value of money in the business, or absolutely scarcity with the buyer, gains seem likely hereafter to be rather in the direction of cheapened methods of construction and simplification of design."

The paper was discussed by Mr. Porter, who thought it a little premature, as the century is not yet closed. He is now engaged upon an engine which he thinks will give the doctor something to write about within a year, and the record should be kept open. A written discussion by Mr. Stanwood was read by the secretary, in which the Rankine and Nordberg cycles were compared from a thermo-dynamic standpoint.

The second paper was entitled:

The Berthier Method of Coal Calorimetry.

BY C. V. KERR.

At the Washington meeting of June last, while the report of the boiler trial committee was under discussion, Professor Kerr made some remarks in which he advocated the use of the Berthier method for determining the heating value of coals as preferable to the Mahler bomb calorimeter, recommended by the committee. The committee considered this contribution to the discussion to be worthy of presentation as a separate paper, and it has therefore been put in the present shape. Some tables of different determinations of the heating power of the same coals are included, in order to show the uniformity of the results. The method is considered by the author to be simpler and to have fewer sources of error than that of the Mahler bomb.

A written discussion from Professor Kinealy was read by the secretary, in which it was asserted that the Berthier method is no more than a plan for finding the amount of oxygen necessary to burn the coal, and that it is worthless as a method of finding the heating power of a coal, though it may be used in a comparative way under suitable restrictions.

The next paper described a

Test of Two Million Gallon Pumping Engines at the Baden Pumping Station, St. Louis Water Works, June, 1899.

BY JOHN A. LAIRD.

A description of such features of the engines as are novel and of the methods of making the test and of verifying the accuracy of the apparatus forms the greater portion of this paper. Following this come the usual tables of data and results of the computations which show the very remarkable duty of 160,166.000 and 161 240,000 foot pounds per 1,000 pounds of feed water, respectively. The builders of the engines were the E. P. Allis Company, of Milwaukee, who, by the terms of the contract, earned, it would appear, the comfortable sum of $30,000 on each engine as a bonus for a performance superior to the contract figure.

In the absence of the author this paper also was read by the secretary. It did not draw out any discussion, and, from the intricate nature of the subject, the secretary read the next paper by title only, the subject being:

A New Graphical Method of Constructing the Entropy Temperature Diagram of a Gas or Oil Engine from Its Indicator Card.

BY HENRY T. EDDY.

The title of this paper may be taken as a synopsis of it. Beginning with the indicator card, which is a volume pressure diagram, the author first shows how to graphically construct from it a volume temperature diagram, in which the volumes and temperatures appear as co-ordinates, and then from this he goes on and constructs the entropy temperature diagram. The paper presupposes a knowledge of the subject, but in the increasing attention being given to the thermo-dynamic analysis of engine performances, it will be found of decided interest by those who devote themselves to this subject.

There was no discussion upon this paper, and the next one, being quite mathematical, was also read by title, the subject being:

Pressure in Pipe Due to Stoppage of Flowing Liquid.

BY GEORGE M. PEEK.

This is an analytical determination of

*Any of the papers may be obtained from the secretary at 12 W. 31st Street, New York, at a nominal cost.

the strains induced in a system of piping by water hammer. The cases of instantaneous and gradual stoppage of compressible and non-compressible liquids are discussed. A knowledge of the moduli of elasticity of the liquid and the material of the pipe is essential to the use of the formulas.

A written discussion of this paper by Mr. Wilfred Lewis was read by the secretary. He criticised the paper as being obscure in its analysis and uncertain in its notation, while some of the assumptions he considered to be clearly inadmissible. The subject he considered to be of considerable importance, though the actual conditions are so much more complex than those assumed that it is doubtful if it is susceptible of satisfactory analysis.

WEDNESDAY AFTERNOON EXCURSIONS.

After luncheon, which was served in the basement of the Society house, and after a session of conversation and renewal of acquaintances, excursion parties were organized. One of these went to the Hewes & Phillips Iron Works, of Newark, and inspected some Diesel motors being built there, and another went to the office of the "American Machinist" and inspected the printing plant and the process of making half-tone plates.

WEDNESDAY EVENING SESSION.

This session was not called to order until 9 o'clock, the delay being intentional, in order to further what is confessedly the most enjoyable feature of these meetings —the reunion of old friends. The first paper of the evening was taken up promptly on the fall of the gavel, the title being the

Compression and Liquefaction of Gases.

BY ARTHUR L. RICE.

This paper is an outgrowth of the meetings of the junior members of the society, having been first given at one of those meetings. It opens with a historical account of the progress in liquefying various gases, but its chief topic is, of course, the liquefaction of air, and it is probably the best account of this great achievement that has been presented this side of the Atlantic. A table of physical constants of various gases is included, and at the close are some calculations on the value of liquid air as a source of power.

The paper was read by title by the secretary, and no discussion followed the reading. The next paper was treated in the same way, and likewise received no discussion. Its title was:

A Curved Glass Blueprint Machine.

BY PAUL M. CHAMBERLAIN.

The author here describes a blueprint apparatus which he has had in use for three years, and which has given excellent results. The glass is a segment of a cylinder of 13 feet radius, the sensitized paper and tracing being stretched upon its convex side. A convenient frame provides for removing the glass, training and tilting it to the sun, and running it out of the window. The leading object of the arrangement is, of course, the securing of positive contact between paper, tracing and glass.

The following paper was also read by the secretary, but in abstract. The title was:

A Metal Dynamograph.

BY PAUL M. CHAMBERLAIN.

The machine described in this paper was designed to give a definite test of the machinable qualities of cast-iron specimens. It consists of a lathe, swung as a cradle dynamometer, and an autographic recording apparatus by which the pressure on the tool is determined. The paper is not complete, as some of the plates called for in the text do not appear, and there are apparently some errors in the references to the cuts. These will, no doubt, be corrected before the paper appears in permanent form. A table of results is, however, given, and the statement is made that the experiments show the pressure on the tool to be independent of the cutting speed, and that the metal removed is proportional to the pressure, measured at a constant radius.

In discussion, Mr. Supplee stated that some similar and very elaborate experiments had been made in France. He stated that he would send the results to the secretary for incorporation in the Transactions.

It was fortunate that the above papers were so quickly disposed of, as the remaining time proved all too short for the discussion of the last paper of the evening program, entitled:

Education of Machinists, Foremen and Mechanical Engineers.

BY M. P. HIGGINS.

This paper is of the first order in interest and importance and relates to a subject in which all are interested. Coming from the man who for twenty-eight years was the superintendent of the Washburn Shops of the Worcester Polytechnic Institute, it is doubly significant. We hear it said on all sides that school shops must devote their attention to exercise work and that commercial work in them is impracticable, and yet at the Worcester Institute shops commercial work has been done for the past thirty years, and, as Mr. Higgins shows, with a profit.

As the result of his experience there, the author says: "I wish to say that * * * nearly all of the grounds for objecting to the introduction of real productive shops as a part of technical and engineering training are imaginary;" and such a statement, from such a man, may fairly claim to close the discussion on this topic.

Mr. Higgins's paper is an eloquent tribute to the worth of the shop boy and a plea for better educational facilities for him, together with a statement of an organization of school and shop for his benefit. This he calls the half-time school, the plan being that the pupils shall alternate in attendance between school and shop, a day's working time being devoted alternately to each.

While the paper is written in the most broad-minded spirit and repeatedly acknowledges the great good accomplished by the engineering schools as at present organized, it cannot be considered as other than, to a certain extent, an arraignment of these schools. He refers to the constant "raising of the standards" for admission, and points out how this has put the schools out of the reach of the shop boy—his sentiments being almost a repetition of those which we have repeatedly expressed in the past. He also says flatly that a large proportion of the graduates of the schools are practically failures; that there is an over supply of such graduates, and that they experience great difficulty in finding employment, because "the proprietor * * * is more and more inclined to trust his engineering to his own men who have grown up in the works and have, in some way or other, picked up science enough to get on with considerable success." Under this head his remarks refer to the conditions in Europe more than in this country, but he states that the total number of students in the engineering schools of this country is on the decrease, this decrease amounting to 15 per cent. between 1894 and 1897.

A large number of contributions to the discussion of this paper had been sent to the secretary in writing, and several of these had been put in type. They were read in part by the secretary and in part by Dr. Thurston. They comprised remarks by President Melville, Professors Hutton, Thurston and Sweet and Col. H. S. Haines. Dr. Thurston had obtained opinions of numerous teachers at Cornell University and incorporated them in his contribution. The opinions expressed were very diverse and can hardly be satisfactorily summarized here. Remarks were also made, either from manuscript or orally, by Professors Richards and Johnson. Mr. Baldwin made a very apt comparison between education and gun construction. The old type of gun was heavy, badly designed, highly ornamental, fired a soft shot at low velocity, made a great deal of noise and smoke, and was aimed at the clouds in the hope that in falling it would hit something somewhere. The modern gun is light, well designed, entirely without ornamentation, fires a hardened steel shot at high velocity, and makes but little noise or smoke. It is, moreover, aimed at the mark, and usually hits it. The comparison with the old and the new education is obvious. Mr. Rogers brought down the house with numerous apt and witty remarks, and Mr. Fritz made an eloquent plea for the education of the sons of the bread-winners. Mr. Christie described the system of apprenticeship and the methods of selection employed at the Pencoyd Iron

Works. The regular term is three years, and where the applicant has been through either a trade school or a manual training school, credit is given for this by a reduction of the length of the term, the credit in some cases reaching two years. Especially, however, they see to it that the boys are given a chance at different kinds of work. The foremen are under positive orders not to keep a boy at one machine for an undue length of time. He considers the opposite course was due to the inertia of the foremen more than to anything else, and is convinced that the best interests of the employer demand that the boys be given a chance to develop. The boys are watched and those who show aptitude are put into the drawing office, the chemical and the testing laboratories; most of those employed in these departments having been selected in this way. On the contrary, those who show most aptitude as skilled mechanics are given every possible opportunity to develop in that direction. Some of the men trained in this way have gone out to other fields of work, and among them are some who receive salaries that would be thought entirely respectable by professional men.

The discussion continued until 11:30 o'clock and was finally stopped owing to the lateness of the hour. Several who desired to speak were unable to do so and promised to contribute their remarks in writing to be added in the Transactions.

THURSDAY MORNING SESSION.

This session opened with a paper entitled:

Experiments in Using Gasoline Gas for Boiler Heating.

BY HERMAN POOLE.

This short paper gives a general account of some experiments in burning gasoline gas under a boiler, with a table of data which do not appear to have been taken with any great degree of accuracy.

The author stated that the experiments were undertaken in the interest of those who expected to find in gasoline gas a cheaper fuel than coal. The paper was offered for what it is worth and as a contribution to the subject, not as a settlement of anything.

The next paper was read by the secretary, and by title only, that title being:

Friction of Steam Packings.

BY C. H. BENJAMIN.

This short paper gives an account of some experiments made to determine the friction of piston rod packings of various patterns and makes. A closed cylinder, with a stuffing box in each head and a rod running clear through, was reciprocated by a crank. Steam was admitted to the cylinder and the power required to drive the apparatus was measured by a dynamometer. Tables of the results of the experiments are given, and the general conclusions are as follows:

1. That the softer rubber and graphite packings, which are self-adjusting and self-lubricating, consume less power than the harder varieties. The old braided flax style gave very good results.

2. That oiling the rod will reduce the friction with any packing.

3. That there is almost no limit to the loss caused by the injudicious use of the monkey-wrench.

4. That the power loss varies almost directly with the steam pressure in the harder varieties, while it is approximately constant with the softer kinds.

Mr. Colvin offered a written discussion in which were given the details of another set of experiments on the same subject by Professor Reeves, which showed a great superiority of metallic over fibrous packing. Mr. Longstreth said the paper was disappointing, as the experiments departed too widely from the conditions of practice to make them of much value.

Following this came another paper, also read by title, on the subject:

Friction Tests of a Locomotive Slide Valve.

BY FRANK C. WAGNER.

The tests here reported were made at the Rose Polytechnic Institute. A locomotive had its wheels and crossheads blocked in position. The backing eccentric rod was disconnected from the link and an electric motor was connected to the free end of the link and in such a way as to drive the link motion and valve. The current readings, corrected for the efficiency of the motor and the friction of the connections, give the power consumed, from which the friction in pounds and coefficient of friction are calculated. Readings were taken under two pressures of steam, 42 and 122 pounds. The total pressure on the valve was figured from the entire area outside the balancing strips, and on this basis the coefficient of friction was found to be 5 per cent. for 42 pounds pressure and 3.6 per cent. for 122 pounds.

In discussion, Professor Smart objected that the experiments do not represent working conditions, as the cylinder pressure is absent. He also objected to the assumption that the total pressure on the valve is that due to its area multiplied by the pres ure per square inch, and referred to Professor Robinson's experiments showing a creeping film of steam in the joint. Mr. Gidding's paper on the same subject, read at the Chicago meeting, was also referred to. Mr. Halsey called attention to the experiments of Mr. Aspinall, reported in the Proceedings of the (English) Institution of Civil Engineers, and reprinted in the "American Machinist" recently, saying that they were much more extensive than these, and, moreover, were made with a dynamometer in the valve stem and on the road under running conditions. Mr. Basford objected that the speeds were too high and the range of the experiments too narrow.

Following this, two papers were read together by their authors, the titles being:

A Note on Flywheel Design.

BY A. J. FRITH.

At the last annual meeting of the society, in discussing Professor Benjamin's paper describing his experimental bursting of small cast-iron flywheels, Mr. McBride showed by a blackboard sketch a flywheel which, under excessive speed, had cracked in several places without letting go, and this note of Mr. Frith's is brought out from his consideration of Mr. McBride's remarks.

The method of flywheel design advocated is one by which the arms shall be so proportioned and so loaded that they will have the same unit strains as the rim, the idea being that they would then extend to the same scale and thus prevent distortion of the wheel due to different unit strains in its different parts.

A Broken Flywheel and How it Was Repaired.

BY JAMES M'BRIDE.

The remarks by Mr. McBride at the last annual meeting, which brought out Mr. Frith's "Note on Flywheel Design," were also the source of the present paper. In it Mr. McBride shows how he repaired the wheel by reinforcing tension rods connecting the rim segments with the hub. The wheel is a large one, being 26 feet in diameter by 90 inches face, and weighing between 30 and 40 tons. At the time of the repairs it ran 20 hours out of the 24, each stoppage being of one hour only, and the repairs were all made during these periods and without the engine losing a working hour.

The two papers were discussed together. Mr. Porter considered unequal shrinkage and internal strains to be chiefly responsible for the bursting of small wheels. When such a wheel bursts it is because it was unintentionally designed to burst. Professor Sweet fully agreed with Mr. Porter, and instanced a case in his own experience where a change in the proportions of flywheels without a corresponding change in the methods of casting had been followed by broken wheels. Another speaker had seen broken wheels of all types, and on the other hand had seen wheels of all types that endured indefinitely. He had never seen a broken wheel that he did not consider the fault of the foundryman. Mr. Cristie said he was now using steel for high-speed wheels and was running wheels of this material at 10,000 to 15,000 feet peripheral speed per minute. Mr. Raynal considered the workmanship of prime importance, and instanced a case of a burst wheel, in which the design was excellent and the castings superior, but in which the arms were secured to the hub by rough bolts in cored holes, and the appearance of the parts showed that there had been a movement of ¼ inch by the parts.

The title of the next paper was:

An Efficiency Test of a One Hundred and Twenty-five Horse-power Gas Engine.

BY C. H. ROBERTSON.

The engine whose test is here reported is one of the Westinghouse make, located at Lafayette, Ind., where it drives an electric lighting plant. The test, as laid out, was very thorough and complete, though some unfortunate accidents made some of the results defective. The test will stand, however, as an important contribution to our knowledge of the performance of large gas engines. The fuel used was natural gas, of which the average consumption was 14.18 cubic feet per indicated horse-power per hour, when reduced to a temperature of 62 degrees Fahr., and a pressure of 14.7 pounds per square inch. The average thermal efficiency of the engine was 14.613 per cent. The engine was one of the first lot of its make and size to be installed for commercial service, and it is naturally expected that a test of a strictly up-to-date engine would show better results. It is intended to overhaul and modernize the engine during the coming winter and another test is promised after these changes have been made.

The discussion was opened by Dr. Thurston, who considered the paper valuable because it gives some unique data regarding the performance of large gas engines. Among other things, the test indicates that the jacket losses do not grow smaller with increase of size, and that the sum of all the losses is about constant. Mr. Edwin Rood called attention to the requirement of the service that the speed be regular. Mr. C. E. Sargent considered the results disappointing, as they show no improvement in efficiency. The results, he considered, in fact, a surprise to those who have come to look upon the gas engine as having about twice the efficiency of the steam engine. He related a case in which the exhaust gases of a gas engine were made to generate steam for a steam engine, the result being that about as much power was obtained from the steam engine as from the gas engine. What is remarkable is that the gas engine works so well under the very high temperatures employed in the cylinder.

At this point some remarks by Mr. Frith, who had been absent at the reading of the paper were made on the paper of Professor Eddy on "A Graphical Method of Constructing the Entropy Temperature Diagram." The methods he considered very clever and practical, but he considered that a serious error had been made in applying the method to the Diesel motor diagram, inasmuch as no allowance had been made for the charge of air admitted with the fuel supply. The work assumes the weight of gas to be constant for both sides of the diagram, which is not the actual case.

The next paper was on the

Strength of Steel Balls.

BY J. F. W. HARRIS.

We have here some experiments on the crushing strength of steel balls, which are the most complete of any we have seen. The apparatus used is described, and the results are given in both tabular and diagrammatic form. A large number of balls were tested, the sizes ranging between ⅛ and 1 inch.

In the discussion the idea was prevalent that while the experiments were carefully made, they were beside the mark, as the data desired relate to the pressure which balls will stand without abrasion of themselves or their races, and on this data relating to their breaking strength throw no light. Mr. Henning condemned the experiment as of no value, and offered some of his own relating to the determination of the elastic limit of the balls. Other speakers considered the form of the races as of first importance. The statement was made that with some forms of races which are being used no balls will wear well. Mr. Gantt enlarged upon the difficulty of making balls alike. Balls which had been made with every attention to secure uniformity would vary between one and six feet as limits of the fall of a falling weight necessary to crush them. Until balls could be made with a reasonable degree of uniformity, he considered it useless to attempt to formulate rules for their use. Mr. Pratt detailed some of his experience. He had found the best balls to be those of Tungsten steel, but they were not reliable because of great irregularity, and in order to secure uniform results he preferred to use a lower grade of steel. He condemned the bounding test from a fixed hight of drop, which had been advised by one of the previous speakers, saying that he had found it worthless. The next paper was on the

Colors of Heated Steel Corresponding to Different Degrees of Temperature.

BY MAUNSEL WHITE AND F. W. TAYLOR.

This short paper is a record of experiments made to determine, in degrees, the temperature of steel when heated to the points called "blood red," "cherry red," "yellow," "white," etc.

Mr. Metcalf offered a criticism of the color names. Many of these names were entirely fanciful, and no one ever saw white iron unless it was painted. If the color of a piece of iron or steel heated to a so-called white heat be compared with a piece of white paper or with the carbon points of an arc light, it would be seen to be far from white.

Mr. F. J. Miller offered a written communication in which he referred to the experiments of A. A. Simonds on the hardening of steel, a full account of which experiments will be found in the "American Machinist" page 741, volume xviii. He thought a large share of the difficulties in hardening steel came from variations of the strength of the light in the hardening room; that this is inevitable so long as the sun is the source of the light, and natural light should be excluded altogether and the hardening room lighted by properly shaded incandescent lamps.

Mr. Sangster referred to the practice of a friend who employed colored globes over gas jets as standards of color, and bro ght the steel to heats which should show colors corresponding to these. Mr. Henning endorsed the Simonds pyrometer as a practical shop instrument. He considered the paper of little value because the color names were indefinite and conveyed no clear idea of the color indicated from one person to another. Moreover, the pyrometer used was not accurate enough to justify the giving of the temperatures to single degrees. Mr. H. M. Howe knew the experiments had been made with great care, and he considered them useful and valuable.

At the conclusion of the session the secretary announced that Mr. Brashear would have one of his diffraction gratings on exhibition in the society parlor. As our readers are aware, these gratings are probably the most minutely accurate of mechanical constructions. The piece is a concave mirror of speculum metal of about 6 inches diameter with the ruled band or grating of about 2 inches width across it. The radius of the surface is about 21 feet 6 inches, we believe, and the surface is true to within a millionth of an inch. The spacing of the rulings is uniform to within one two-millionth of an inch. The tests for accuracy are of course optical and not mechanical.

THURSDAY AFTERNOON EXCURSION.

The excursion of Thursday afternoon was to the power plant of the Waldorf-Astoria hotel, the party being taken in charge by Mr. C. R. Pratt. Few people have any idea of the extent of the steam-power equipment of these modern hotels. The Waldorf-Astoria plant contains twelve boilers of the B. & W. make, we judged, aggregating 4,000 horse-power. In the entire plant there are 167 steam cylinders and 25,200 electric lights. Of the engines six are Allis Corliss, connected direct to Walker generators. Of these four are of 400 horse-power each, the remaining two being of 200 horse-power each. The engines are simple and non-condensing, because of the absence of condensing water and also because of the opportunity for utilizing the exhaust in warming the building. The refrigerating plant consists of three 50-ton machines. There are 200 ventilating fans, of which ten are of large size. The elevators, dumb waiters and hoists number in the aggregate thirty-four, of which seventeen are electric and seventeen hydraulic. The amount of coal burned per day ranges between 65 and 150 tons, while the normal number of men in the engineering department is 116. At present, for some reason which we did not gather, this

number is much exceeded, the employees of this department aggregating 220.

In the evening the President's reception at Sherry's, which has become a regular feature of the New York meetings, was held. The superb floor and the excellent music held the company, or at any rate the younger members thereof, together until a late hour. As has happened before at the same place, there was a good deal of justifiable complaint about the supper, especially its service.

FRIDAY MORNING SESSION.

The concluding session of the meeting was opened by a paper on

Impact.

BY W. J. KEEP.

Mr. Keep has devised a new apparatus for testing the resilience of materials by the impact of a falling hammer, and this paper gives the results of some tests with it. The apparatus assumes two forms. In the first the hammer is dropped directly upon the top of the bar, while in the second it swings like the ball of a pendulum and strikes the bar upon its side. The bar is, of course, supported at its ends, and by a pencil carried by a multiplying parallel motion and a moving strip of paper, autographic records of the behavior of the bars are made, and many of these are reproduced as part of the paper.

Of this paper there was no discussion, and the programme continued with a paper on

The Mechanical Equipment of the New South Station, Boston, Mass.

BY WALTER C. KERR.

(Assisted by H. J. Conant, W. W. Churchill, Francis Blossom, J. P. Coleman and Calvert Townley.)

This paper had not been distributed in advance of the meeting. It is of a kind of which the society does not get enough—those telling what has been done and how it was done. Of this class it is unique as a description of a great work never before attempted in the same way. The paper comprises 115 pages, with numerous half-tone and line engravings, and it is literally packed with information for which one may search in vain elsewhere. It is impossible to abstract it here, but we may say that the features embraced by the machinery plant cover an interlocking switch and signal plant, a power house outfit, electric light and power distribution, passenger, freight, baggage and express elevators, heating and ventilating apparatus, ice plant for cars, restaurants, etc., water filtering and cooling plant, car heating plant, compressed air supply, fire protection plant, disposal of storm water and some other minor features.

The magnitude of the plant is on the same scale as its diversity, and the design and construction of the whole was undertaken by the Westinghouse interests. Measured by the number of simultaneous train movements which it has to handle, the plant is the largest in existence. The cost of the mechanical equipment supplied by the Westinghouse interests was nearly three-quarters of a million of dollars. As the paper had not been distributed in advance, the members were taken by surprise when its character was disclosed, and its effect was electrifying. No other paper of the meeting, except that of Mr. Higgins, received so thorough or so appreciative a discussion. The plant was looked upon as the latest development to date of the possibilities of the American system of engineering in doing such work, and it shows that one may buy a plant of this kind in the same way that he would buy a sewing machine, direct from the maker—the engineer and the contractor being the same person—without the work first going through the hands of a consulting engineer. The danger of corrupt methods under both systems was discussed, the general impression being that there were dangers under both systems, and that in the last analysis, and under either or any system, it becomes finally a matter of personal integrity. Mr. Kerr, in his closure of the debate, said that in his opinion the great advantage of the system lies in the fact that it fixes responsibility in a way which is impossible except when the engineer and contractor are the same party. At the same time, he does not consider that any one method can be absolutely the best. There is room for all systems and for every man of whatever kind of talent.

The next paper taken up was entitled

High Hydrostatic Pressures and Their Application to Compressing Liquids—A New Pressure Gage.

BY FRANCIS H. STILLMAN.

The West Virginia Agricultural Experiment Station has been engaged upon the effect of high pressures upon the bacteria which appear in milk, and for this purpose has employed a hydraulic press and some special apparatus by which pressures as high as 450,000 pounds per square inch have been obtained. This apparatus, by a slight modification, has been adapted to the measuring of the compressibility of liquids, and the results are very surprising. Thus, under a pressure of 65,000 pounds to the square inch, water is compressed over 10 per cent. and alcohol over 15 per cent. These results and the apparatus used are suggested as the basis of a new pressure gage for high pressures and of great accuracy. It is stated that by such a gage differences of a pound throughout the range of several hundred thousand pounds can be detected.

In the discussion Professor Jacobus described a hydraulic packing which he had used for high pressures, which was essentially a cup leather packing, except that a suitably shaped piece of bronze was used instead of a leather ring. The author stated his intention to be to get more particulars and details of the experiments before putting the paper in final shape.

The concluding paper of the session and of the meeting was on

The Value of a Horse-power.

BY G. I. ROCKWOOD.

This paper relates the case of the city of Worcester, Mass., which had taken for a source of water supply the Blackstone river, and in doing so had destroyed the value of eighty developed water-power privileges. A suit for damages was instituted against the city by the combined owners, and the paper gives a statement of the positions of the experts employed by the two parties, together with some of the testimony. The author criticised especially the testimony of Mr. Kent, and that gentleman replied to the criticism very effectively. He said that while the oath of a witness required him to give "the truth, the whole truth and nothing but the truth," the fact was that he was only allowed to answer such questions as were put to him, and that these might be and often are cut short before the whole case is stated, the result being that the testifying expert may be placed in a somewhat ridiculous position. Mr. Rockwood's paper concluded with a motion empowering the council to appoint a committee which should determine the basis upon which a horse-power should be valued, and the motion was carried.

The meeting was then closed with a few remarks by the retiring president, in which he expressed his feelings that of all the honors that had come to him in the course of a long life, he considered the honor of his election to the office of president of this society as first.

In point of attendance the meeting was the largest in the history of the society. The registered attendance numbered 706, against 610, the highest previous record. In point of interest, too, the record is a high one. The papers, it was generally admitted, were above the average in point of interest, while two of them were discussed with a thoroughness and interest which the writer has never seen equaled.

The next meeting will probably be held in Cincinnati.

Letters from Practical Men

Catching Fractional Threads in Screw Cutting.

Editor American Machinist:

We do not know that the following will be of any service to anyone, or even that it is new; however, it is new for all of us around here.

In cutting a thread with a fractional number of turns per inch and desiring to run the carriage back by hand, all that is necessary is a glance at the denominator of the fraction, which, if in its lowest term,

will give the least number of inches that the thread can be caught or any number that can be equally divided by the denominator.

The reason for this is that the denominator is the lowest number by which the whole number and fraction can be multiplied to produce a whole number.

JAMES J. ENGLISH.

Wilmington, Del.

[We believe this method is not new, but is not as well known as it might be. Another way of explaining its principle is to consider that the carriage must be moved back a distance which will move the tool over a whole number of threads of the screw being cut, while at the same time the nut moves over a whole number of threads of the lead screw. So if, for instance, the number of threads per inch to cut is 2½ and the lead screw is 2 per inch, the denominator of the fraction (2) gives 2 inches for the movement, and this carries the tool over five threads of the screw being cut and over four threads of the lead screw. If the screw to be cut were 1⅓ threads per inch, the movement of 3 inches would carry the tool over $1\frac{1}{3} \times 3 = 4$ threads of the screw being cut and over $3 \times 2 = 6$ threads of the lead screw. —Ed.]

Blank Diameters for Drawn Work.

Editor American Machinist:

Noticing on page 33 of the September 28 issue of the "American Machinist" an article upon finding the diameters of blanks in drawn work, I write to refer readers interested in the subject to the rules and formulæ mentioned on pages 204 to 209, inclusive, of my book, "Press Working of Metals."

Outside of guess work, the different systems therein mentioned are: first, the *tentative*, where the cutting edges of the dies are left unfinished until last, and the proper diameter is then determined by actual trial of various blanks; second, the *gravitative*, where the size of the blank is found by weighing the work to be reproduced and calculating by comparison the area and consequent diameter from the same kind of sheet metal of known thickness and weight; and third, the *mensurative*, of which two distinct methods are described. Both of these are based upon the assumption that the average thickness of the metal will be the same after drawing as it is in the blank, which, as explained, is often the case in actual work. The calculations in connection therewith are, of course, based upon the simple principle mentioned in the recent article referred to by Mr. Painter, of equal surface areas of blank and cup.

The first of the two methods cited in speaking of the mensurative system is described on page 206, and is essentially the same as Mr. Painter's, if we omit that part of it relative to round-cornered cups and assume that they are all sharp-cornered, or approximately so.

Mr. Painter starts, however, with the circumference of the cup (or "shell"), and the area of its bottom, as known quantities, represented by C and A, respectively, whereas these must be found by calculation before his formula can be used. After finding these and working out the formula, the result is given as the square of the blank diameter, represented by D^2, after which another calculation must be made, consisting of extracting its square root. It will be seen, therefore, that his formula, although correct, is not complete in itself. In contrast therewith I call attention to my formula 3, page 206,

$$x = \sqrt{d^2 + 4\,dh}.$$

In this x is blank diameter, d cup diameter and h cup hight. Substituting his letters and completing his calculations, so as to attain the utmost convenience in figuring from the cup itself, the formula would read $D = \sqrt{d^2 + 4dH}$, where D = blank diameter and H cup hight.

The table which Mr. Painter has given is doubtless based upon this formula, and it appears to be an extremely convenient one, although I have not had time to examine it critically. It is only a wonder that such tables have not been worked out before and duly made public, preferably amplified by taking every 1-16 inch instead of every ¼ inch, and by running to greater diameters and depths than the 6 inches given in each case. OBERLIN SMITH.

Bridgeton, N. J.

Interpretation per Telephone.

"Zdravstvooeetyeh, Soodar! Govoreetyeh lee vüh po-rooskee?"*

A well-dressed stranger thus greeted me in my office. But though the salutation was Russian, the accent was not, and the dress and type had in them something of the Orient.

Now my Russian, outside of the most absolutely necessary phrases for traveling, consists of the question, "Is there anyone here who speaks English, German or French?" so I replied, "Ya ponemayoo nemnovo, no govoreet ne oomyayoo po-rooskee," which being interpreted means "I understand Russian a little, but do not speak it." I then learned that my caller was an Armenian, and that he evidently meant business of some kind; but just *what* was the puzzle. French and German were all Greek to him.

After grinning at each other a minute or so, I remembered that I had an acquaintance in the Technical High School who, being a Bulgarian, could manage to understand and be understood by Russians (the language being about as similar as Spanish and Portuguese or Italian); and while his German, like that of most Slavs, including the Bohemian, had a "burr" on it which casts Scotch-English into the shade, it was good enough for all practical purposes. So I motioned to my visitor to wait a little, and had the "Polytechnician" called up on the 'phone. It took, luckily, but a few minutes to have young Bogdanoff (Theodore-son, we would make it) brought up to the instrument, and thence on it was pretty plain sailing. The Armenian informed the Bulgarian in Russian what he wanted; the Bulgarian told me in German, and so on, to the end of the chapter, which was a pleasant one.

ROBERT GRIMSHAW.

*Good morning, sir! Do you speak Russian?

Irregular Curves vs. Arcs of Circles.

Editor American Machinist:

I would like to say a word or two with regard to drawing irregular curves. It seems to me the subject comes to just this: What kind of a pattern maker is to do the job? Is he the kind of a man who wants every point in an irregular curve given him in sixty-fourths of an inch, with a typewritten sheet of specifications and a lifetime to do the job in, or is he one who, when the essential dimensions, diameters, distances between centers, necessary sections are given him, has mechanical "gumption" and artistic sense enough to whittle it out? I believe in making drawings plain enough to show what is wanted, and in using arcs or irregular curves, according to the requirements of the work to be done; preferably arcs, because they are easier to make for all concerned. A pattern maker who understands his business will do the rest, and that is the kind of a man an employer pays for and what he has a right to expect from him.

RALPH C. SIMMONS.

Winchester, Mass.

The Brachering Process.

Editor American Machinist:

Will you allow us to correct an error in your obituary notice of Mr. T. W. Bracher, November 30, 1899?

The "Brachering process" (so called only in England) is that of overstitching the raw edge of the leather sweat bands, previous to putting them into hats, which latter work is largely done by hand in England; as the writer found to his sorrow last August when in England, trying to introduce machines for stitching "Brachered" and other leather into hats.

We do not think that Mr. T. W. Bracher was an inventor of machines for stitching sweat bands into hats. There have been various machines for this work made in the last fifteen years, and of late we have been "cutting a little ice" in that line ourselves. DURBROW & HEARNE MFG. CO.

New York.

Boiling it Down.

A story is told of the editor of a go-ahead evening newspaper, who, in the eternal rushing to press to get ahead of his rivals, was continually impressing upon

his reporters the necessity of condensing all news. On one occasion a terrible boiler explosion had taken place on board a big ship lying at Portsmouth. "Get down there as fast as you can," he said to one of his men; "if you catch the 11:40 you will be there soon after 2, and you can just wire something for the extra special—but boil it down." Soon after 3 o'clock that afternoon they got this telegram from him: "Terrible explosion. 'Melpomene.' Boiler empty. Engineer full. Funeral tomorrow. No flowers."

Personal.

H. L. Cameron has recently taken a position as foreman of the planer shop with R. K. Le Blond, Cincinnati, Ohio.

Will the reader who inquired regarding mufflers for gas engine exhaust pipes please send his address to this office?

Thomas Smith, United States Consul at Moscow, Russia, recently arrived in this country, and will remain several weeks.

Professor Burstall, professor of mechanical engineering in Mason College, Birmingham, England, together with Prof. J. H. Pointing, professor of physics, and Director G. J. Kendrick, who have been visiting the United States in the interest of their new engineering building, spent Saturday, 25th ult., going over the engineering plant of the University of Pennsylvania.

C. F. Tucker, who has been the European representative of The Pratt & Whitney Company for the past three years, severed his connection with that firm on the 13th of November last, and sailed for Europe on the steamer "St. Paul" on the 6th of December to represent the owners of the foreign patents of the Waltham two-speed hub for bicycles. He will visit England, France, Germany, Belgium and Austria-Hungary. His London address will be Dekeyser's Royal Hotel.

Obituary.

Charles P. Howell, who was chief engineer of the battleship Maine when she was destroyed, died in this city December 7, fifty-one years old. Commander Howell was a graduate of Annapolis and had a total naval service of twenty-seven years, nearly eighteen years being sea duty. He was assigned to the Brooklyn Navy Yard last summer, with the relative rank of Commander.

German Opinion of American Iron and Steel Industries.

The German press regarded with some suspicion the purposes and probable results of the recent commercial exposition at Philadelphia. This feeling of distrust has, however, been removed, according to a consular report just received from Germany. In this same report there is given an account of an interview with the director of a leading German steel plant, in which he expressed himself regarding the iron and steel industries of the United States. Being asked what significance the recent exposition at Philadelphia bore from a German standpoint, he said: "It had by no means the anticipated one-sided character of a source of information for Americans only, but was of equal interest to foreigners. Concerning the industrial situation in the United States, the impression derived by a foreigner is that the present remarkably favorable conditions are solid, legitimate and likely to be permanent. This is particularly true of the mining and metal industries. An important element in the present unparalleled prosperity of these interests in America is the strong, steady, continuous demand for metals, particularly those used in electrical machinery and installations. It is also true that America far surpasses us in the use of iron and steel for building purposes.

"It is undeniable that the American iron works operate under decidedly more favorable conditions of production than our own. An important factor in these conditions is the fact that the United States possesses far richer and more widely distributed iron-ore deposits than Germany. While we are largely dependent upon imported ores—especially Swedish—the American iron works find their raw material at home. To this must be added the other important advantage, that the construction and equipment of their iron and steel works far excel those of Germany, and indeed every other European country. In America we find what seems to us an astonishing substitution of machinery for manual labor. Only in the most necessary details is hand labor now employed. Such a vast and skillful application of machinery offers especial advantage in a time like this, when manual labor is costly and difficult to obtain.

"Finally, comes the enormous advantage which the Americans enjoy through the high development of their railway system. The industries have at their command a railway system which far surpasses in cheapness and efficiency of service anything known in Europe. The first sight of the tracks and equipment of an American railroad makes upon a German an imposing impression. Their freight cars of all classes far surpass in size and carrying capacity those of the German railways. Their track system is relatively broader and stronger than ours. Special tracks for freight trains secure rapid, almost unbroken traffic. A widely developed system of branch and side railways (feeders) sustains the traffic of the principal lines. The rates for freight are excessively low. While on the German railways, the cost of freight per ton kilometer is (excepting some unimportant special tariffs) 2.2 pfennigs, in America the corresponding rate is only 0.6 pfennig per ton kilometer.

"Under these conditions, the German iron industry finds in that of the United States its greatest, most important and most dangerous competitor. Just at present, the full force of this competition is not apparent because there is an enormous home demand for iron and steel in Amer-

(*Continued on page 48.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer. Mach. T. Co., Meriden, Ct.

Punches & dies. Wal. M. Wks., Waltham, Mass.

Rawhide, fibre and hard rubber gears. The Arthur Co. (See page 8.)

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking." $1, post paid. J. L. Lucas, Bridgeport, Ct. Send for index sheet.

Parallel attachments for drawing board or table, $1.50. F. G. Hobart, Beloit, Wis.; cir'lrs.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

For Sale—Two geared Ferracute presses, 62 in. between uprights; little used, and in good condition. Address W. H. Mullins, Salem, Ohio.

Mechanical engineer solicits correspondence with capitalists or manufacturing concerns who want to build an improved high-speed engine. Box 52, AMERICAN MACHINIST.

Would be pleased to correspond with parties having some specialty in the line of machinery to build, by one of the best equipped machine shops in the State. Address Box 475, Hornellsville, N. Y.

A commercial house of Switzerland desires to enter into business relations with an American machine manufacturing concern, on account of representation for sewing machines. Box 51, AMERICAN MACHINIST.

Wanted—Manufacturer or partner, to build a new style of printing press; no experiment; tried and proven a success; the press is fully protected by patents. Address "Good Opportunity," AMERICAN MACHINIST.

Engineers, firemen, machinists and electricians, send 10 cents for 24-page pamphlet containing list of questions asked by Examining Board of Engineers. Geo. A. Zeller, bookseller, St. Louis, Mo. Mention AMER. MACH.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Manufacturers intending to introduce practical patented novelties of every description on the European market are requested to communicate with Adolf Heerdt, 15 Schillerstrasse, Frankfort-on-Maine, Germany, importer and general merchant. A1 references given and wanted.

A well-equipped machine shop and foundry, with ample water power, capacity 50 mechanics, tools suitable for engine building up to 24 x 24-inch or similar work, invites proposals in their line, or will consider manufacturing new specialties. Address P. O. Drawer 414, Lockport, N. Y.

Experienced engineer, well connected throughout Great Britain and the continent, desires agencies for good American machinery of all kinds; has exceptional facilities for selling patents or arranging for manufacture under royalties; British and American references. Address Brown & Co., 49 Deansgate, Manchester, England.

The annual meeting of the stockholders of the American Machinist Press, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, No. 218 William street, in the city of New York, on the 8th day of January, 1900, at 12 o'clock noon. A. LEIGHTON DONNELL, Secretary.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated.

(*Continued on page 48.*)

(*Continued from page 47.*)

ica. Several shipments of American foundry pig iron to Germany prove, however, that we have in future to reckon with the competition of American metal here at home. Those shipments were ordered by German consumers of pig iron because they were in urgent need of raw material. The belief that the competition of the American iron industry is not yet to be seriously feared may still be cherished in spite of the great development of trusts, concerning whose productive capacity many large figures have been published which it is impossible to verify and which are probably exaggerated.

"But where once a relapse occurs in the American market or a weakening of demand in the world's metal market, then we shall have to reckon with a sharp and powerful competition from America, especially in heavy plates, structural steel and iron, and rails, for the production of all these in the United States is on an enormous scale. Above all is this true in respect to rails, the production of which is developed to an astounding degree. Works which produce only one type of rails are not uncommon."

To the question, How can the German market protect itself against the future competition of America? the following answer was given:

"The German iron and steel works must follow the American example, and by a greatly enlarged use of machinery reduce the cost of production and protect themselves from future contingencies in the labor market. There is also urgently required for our industry much lower freight rates and the construction of special lines and extra tracks for freight traffic. In this respect, also, America is a model and example for us to follow. The construction of canals, which will offer a cheaper method of transportation, can indeed be of advantage, but can only be considered a palliative, not a remedy."

An examination for mechanical draftsman in the Municipal Civil Service of New York will be held on Tuesday, December 19, at the Criminal Court Building, at 10 A. M. Candidates must be residents of the State of New York and conversant with structural drawing, masonry, iron and steel construction. Candidates should bring their own ink, drawing materials and instruments, except paper. Applications should be on file not later than December 16. For further information and application blanks address Lee Phillips, secretary, New Criminal Court Building, New York City.

"That Baltimore woman who gave her pet monkey a first-class funeral must have been greatly attached to the animal." "Yes; it probably gave her a regular monkey wrench to part with it."—Cleveland "Plain Dealer."

(*Continued from page 47.*)

The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Machine tool and special machinery designer wants position. Box 56, AMER. MACH.

Expert draftsman and bookkeeper wants position, downtown New York. Box 47, AMERICAN MACHINIST.

Wanted—Position, by designing mechanical draftsman, 10 years' experience. E. R. W., care AMERICAN MACHINIST.

Competent draftsman, 10 years' experience in general and special machinery, wants position in Toronto (Canada) or vicinity. Box 59, AMERICAN MACHINIST.

Position traveling mechanical engineer; 15 years in shop, office and field; steam, electric and hydraulic power machinery. Address Box 43, AMERICAN MACHINIST.

Wanted—Position, by draftsman, designing, mechanical technical education; 10 years' experience; competent to superintend construction. H. R. S., care AMERICAN MACHINIST.

Draftsman and technical graduate desires responsible position; has had shop experience, and is accustomed to handling men; best of reasons for leaving present position. Box 58, AMERICAN MACHINIST.

Mechanical engineer of 20 years' experience with general machinery and manufacturing business, is a good designer, desires engagement as superintendent or master mechanic. Box 57, AMERICAN MACHINIST.

Superintendent, up to date on engines, pumps and general machinery, would like to meet parties requiring a man to take charge of a plant employing from 100 to 300 men. Address Box 42, AMERICAN MACHINIST.

Mechanical engineer, technical graduate and 18 years' experience in hydraulic, steam and general machinery, wants position as assistant superintendent or chief draftsman; first-class designer. Box 53, AMERICAN MACHINIST.

Wanted—Position as foundry foreman, by a reliable, experienced molder; can manage men to advantage to get best results; here is a chance to get a good man. Address C. Dhein, 229 Park st., Dayton, O.

Mechanical engineer, familiar with hydraulic engineering, general machinery and water-wheel construction, is open for engagement January 1; invites correspondence from water-wheel builders wanting to improve upon the efficiency of their wheels. Box 55, AMERICAN MACHINIST.

Mechanical expert is open for engagement as chief draftsman or manager; lifelong experience in printing presses and general machinery; can produce work economically, and is fitted for any responsible position where great mechanical inventive ability and integrity are essential. Address Box 54, AMERICAN MACHINIST.

Practical mechanical engineer open for engagement January 1, as superintendent, associate in engineering office or other engineering work; wide experience in designing high-grade steam engines, boilers, etc., and superintending manufacture of same; limited experience designing electrical machinery; 10 years in present position as superintendent of engine and boiler works; will consider openings at home or abroad. Box 45, AMERICAN MACHINIST.

Help Wanted.

Machinists wanted; regular work and good pay to competent men. Watertown Engine Co., Watertown, N. Y.

Draftsman wanted on mill machinery and machine tools. Apply to Bethlehem Steel Co., South Bethlehem, Pa.

Wanted—A man to take the lead in foundry on cylinder work, in a locomotive works. Address Box 66, AMERICAN MACHINIST.

Wanted—In Massachusetts, four first-class outside and inside erecting men on engine and air-compressor work. Address Box 63, AMERICAN MACHINIST.

Draftsman wanted who can design hydraulic valves; state age, experience and salary expected. Brandywine Machine Works, Wilmington, Del.

Machinist, experienced assembling Wilcox & Gibbs straw sewing machines; permanent position. Durbrow & Hearne Mfg. Co., 12 Wooster st., New York.

Foreman for machine shop; must be energetic and experienced in general engine construction; good position for right man. Box 65, AMERICAN MACHINIST.

Wanted—Experienced draftsman, to work on cotton machinery; good position for an A1 man; state experience, references and salary expected. Address Box 64, AMER. MACHINIST.

Wanted—Experienced foreman, familiar with modern methods, for machine shop employing about 100 men; state age, experience and salary expected Address Box 62, AMERICAN MACHINIST.

Wanted—Foundry foreman of experience and ability, for shop making specialty of Corliss and slide-valve engines, air compressors, furnace work and heavy and light castings. Address Box 48, AMERICAN MACHINIST.

Wanted—Four first-class round and flat die makers and perforation dies; steady work and good pay for first-class men; none other need answer. Apply to Despatch Brass Hardware & Rolling Mill Co., Despatch, Monroe Co., N. Y.

Wanted—An ice machine company desires to employ a first-class draftsman familiar with piping up of power plants; man with practical experience preferred; state experience and wages wanted. Box 60, AM. MACH.

Wanted—Three thoroughly experienced machinery blacksmiths, accustomed to working to drawings; also one foreman blacksmith capable of handling 40 men on general work, including high-class machine forging. Address Box 61, AMERICAN MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from draftsmen, pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—A designing draftsman of A1 ability, practical experience and some theoretical attainments absolutely necessary; must be up to date in jig and fixture work and special machinery; excellent chance for competent man of good character; none other need apply. Address, with details, Box 67, AMERICAN MACHINIST.

Wanted—One or two bright young men, to buy established machine shop in New York, doing good business; is fitted up with best of modern tools, and we will send to party buying, all our trade in this line; an exceptional chance for the right party to start in business, and terms will be made satisfactory to purchaser; price low. Address O. G. N., Box 30, AMERICAN MACHINIST.

BARGAINS IN NEW AND SECOND-HAND MACHINERY.

48 in. Bickford Boring and Turning Mill, 60 in. x 15 ft. Planer, 30 in. x 8 ft. Planer, 60 in. Boiler Makers' Drill, No. 2 Garvin Milling Machine, No. 3 Pratt & Whitney Screw Machine, No. 3 Windsor Screw Machine, No. 3 Bardons & Oliver Screw Machine. New Tools ready for delivery: 24 in. x 12 ft., 18 in. x 8 ft., 18 in. x 10 ft., and 15 in. x 6 ft. Lathes, and 16 in. Shapers.

Frank Toomey, 129-131 N. Third St., Philadelphia

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July 23, 1896.

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We are very much pleased with the filter purchased from you some time ago. It gives us perfect satisfaction, and gives in return a better looking oil than we buy.

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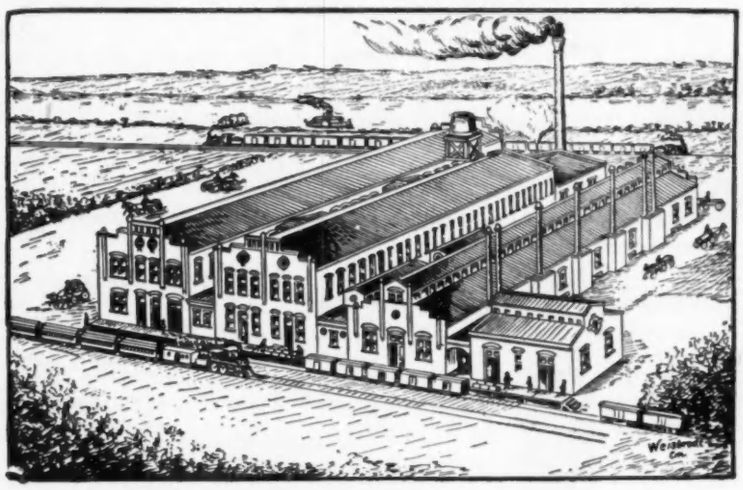

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A friend writes that he wishes to use lead or some fusible metal in a place where it will be subjected to a pressure of 4,000 pounds per square inch. The metal will be in a sheet about ½ inch thick and several feet square. He would like to know if this pressure will cause the lead to flow, and, if so, what alloy can he use instead. Perhaps some of our readers have had experience along this line, and, if so, we would be glad to hear from them.

Inquiries for Machinery.

(115) Machinery used in the manufacture of straw hats.

(116) For the makers of what is known as the Stevens or Stephens portable rotary valve planing machine.

Technical Publication.

"Kinematics of Machinery. A Brief Treatise on Constrained Motions of Machine Elements." By John H. Barr. 247 6x9-inch pages, with 213 illustrations. John Wiley & Sons. Price $2.50.

This book may be briefly described as covering the ground first treated systematically by Willis in the "Principles of Mechanism." The treatment is strictly modern, the conception of instantaneous centers of motion by Professor Reuleaux being the basis of much of the work. To the student who has no systematic knowledge of mechanism from an analytical standpoint, the book can be confidently recommended. As a whole, it is non-mathematical. Simple algebra and trigonometry are used, and occasionally a little calculus appears, but the book is comparatively free from mathematical work. Any intelligent reader may obtain much from it, and with a knowledge of a little algebra and of the trigonometry of right-angled triangles it is practically all readable.

New Catalogs.

The Pearson Jack Company, Boston, Mass., sends us catalog in which is illustrated and described the Pearson car-replacing jack, for use in railway work. The catalog is 3½x5¾ inches.

Laughlin-Hough Company, 30 Broad street, New York, N. Y. ,has sent us catalog in which are illustrated and described their mathematical drawing tables. The various features of these tables are given very minutely, and numerous illustrations showing the different positions in which they may be used are included. The tables are made in various styles, and for those interested in the subject of mechanical drawing we consider this catalog will prove of great interest. It is standard size, 9x12 inches.

Manufacturers.

Contracts have been let by the Warren Electric & Specialty Company, Warren, O., for an addition to its plant.

The Hamilton Machine Tool Company, Hamilton, O., is adding new machinery to its plant. A new building is also being erected.

W. J. Shields, of New Wilmington, Pa., is working on the final drawings for a new elec-

tric lighting plant, to be erected at the same place the early part of next spring.

The C. W. Hunt Company, West New Brighton, S. I., is erecting a new power-house for the purpose of generating electricity to drive the machinery in the several departments.

Bullock Electric Manufacturing Company, Cincinnati, contemplates the building of an addition to its main shop, which extension will make the machine shop 500 feet long and 101 feet wide.

Architect W. E. Creiggs, of Waterbury, Conn., has received bids for the erection of the proposed factory for the Seamless Rubber Company. The structure will be of brick construction, three stories in hight, 42x67 feet in dimensions.

The Southern Iron Works was organized at Tampa, Fla., recently, by D. W. Shea, J. A. M. Grable and Ernest Kreher. The company owns a plant, but will enlarge it and make it the leading marine machinery concern on the gulf coast.

C. J. Clark, president of the Nutley Paper Company, of Nutley, N. J., states that that company will erect a modernly appointed paper mill and wrapping building at Nutley, which will be frame and brick, one and two stories, measuring 75x205 feet.

The Carter Steel & Iron Company has been organized at Knoxville, Tenn., with a capital of $600,000, and the privilege of increasing it to $5,000,000. The new company has absorbed the Blue Springs Mining Company, the Helen Maud Iron Company and the Stony Creek Iron Company.

Architect Robinson, New Haven, Conn., has plans for the erection of a factory building for the Winchester Repeating Arms Company. The structure will be 60x100 feet, and three stories, with a wing 20x20 feet. The building will be of brick and iron construction with asphalt floor and tin roof.

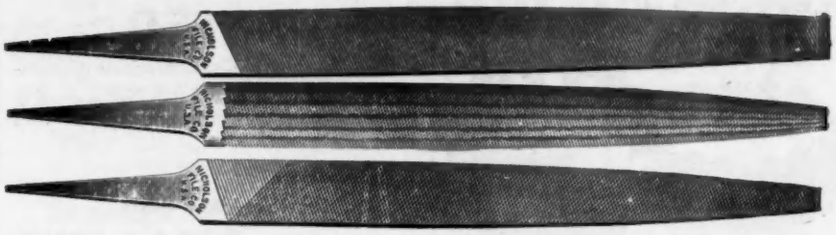
Contractors Macey-Henderson & Co., Heed Building, Philadelphia, Pa., have been awarded a contract for a smith and machine shop building for Mr. Morris. It will be brick and iron, two stories, with a 38-foot front. Interior equipment will be taken up under another contract, and the latest factory appliances will be introduced.

The James River Construction Company, of Richmond, Va., is about to erect a steam power-house for the purpose of operating an electrical railway in that city. The construction and equipment of the power-house will cost $135,000. The Riter Conley Manufacturing Company, of Pittsburgh, has secured a contract for the steel roof trusses.

The General Electric Company is so busy at its works in Lynn, Mass., that it is preparing to erect an addition to the present steel foundry at the river works, situated on the banks of the Saugus river and along the Boston & Maine Railroad. Bids have been asked for a brick building, 150x120 feet in size, to cost in the neighborhood, complete, of $60,000.

Stanley G. Flagg & Co. have awarded the contract for a new foundry building, to be built at Pottstown, Pa., 100 by 110 feet in size, one story high, to be completed within ninety days. This makes the eleventh building erected by this firm on their grounds at Bramcote, and will, when completed, increase the firm's force of workmen by seventy-five molders.

The B. F. Barnes Company is the name of a new manufacturing concern recently organized at Rockford, Ill. They will build a modern plant and engage in the manufacture of drills and lathes. The officers of the new firm are as follows: President, B. Frank Barnes; vice-president, Wm. Nelson; secretary, Allan R. Rea, and treasurer, Samuel H. Reck.



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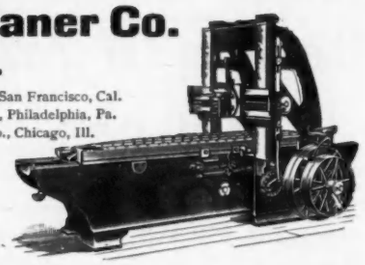

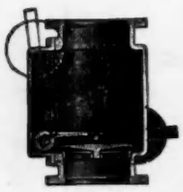

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This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

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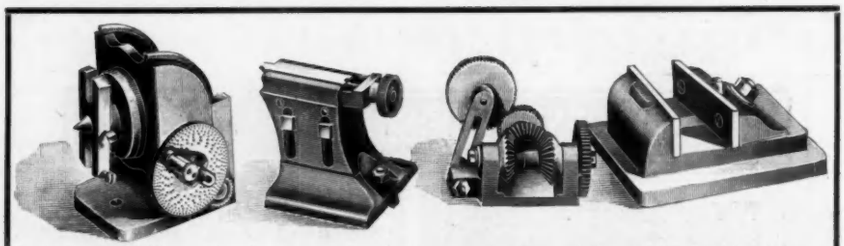

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